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THE SPHERE OF GOVERNMENT INFLUENCE.

THE thoughtful person who endeavours to foretell the effect of proposed legislation by studying the undoubted results of statutes now in force has much food for reflection at the present time. During the last decade, the list of effective Acts of Parliament has increased in an amazing degree. Within the last five years we have seen an enormous number of measures passed in the interest of the working classes. What is the result of it all? What other legislative efforts will be made when the skid which, according to the view of some minds, now clogs the wheel of the State chariot is finally and completely removed?

In former centuries trial was made of a number of sumptuary laws. By these means attempts were made to restrict the output of certain manufactured articles, and to control the liberty of the person. Each and every one of those strange Acts of Parliament now lies in the limbo of forgotten things, "unwept, unhonoured, and unsung." It has remained for twentieth-century Governments to revive at least one of the objectionable features of the old sumptuary laws—namely, interference with freedom of contract.

However attractive for the nonce interference with freedom of contract may be, it is bound in the long run to injure the man whom it is designed to protect; and in so far as it does that, it is an extension of Governmental control beyond its legitimate sphere. John Stuart Mill, at any rate, took this view. He wrote: "When a Government provides means for fulfilling a certain end, leaving individuals free to avail themselves of different means if in their opinion preferable, there is no infringement of liberty, no irksome or degrading restraint."

So long as the Government enforces the fulfilment of contracts, they provide the means for attaining the end. They regulate the dealings of employers with employed, and it is in those relations that readers of this journal take the deepest interest. Those relations—at one time free, or practically free, from Government control—are now hedged about with all kinds of restrictions. The parties are not free to contract one with the other. A may not run a factory unless it is open to the view of a Government inspector. B may not employ able-bodied pitmen for nine hours at a stretch in his coal mine. C may not agree with D, for whom he works, that he will take no advantage of the Compensation Act if he meet with an accident in the course of his employment. Are not all these "infringements of liberty" or "degrading restraint"? *Et cui bono?*

Take the Workmen's Compensation Act. Compare the position of the workman employed by a humane employer 15 years ago and the position of a similar workman to-day. Suppose him injured and placed on the sick list. On pay day the employer would most likely say, "We had better send Tom his wages. Poor chap, he has a wife and

family to keep"! And the result? Realising that he was being kindly treated, Tom would try to get back to work as soon as possible. If unable to do his regular job, he would clean out the yard or assist as best he could. But now, if Tom goes under, it is the hard-hearted insurance company that he has to deal with. He gets half his wages; is encouraged to believe that he will continue to get half wages so long as he is ill, and, getting to like an idle life, he hangs about and becomes a worthless malingerer. If he loses his job, he never gets another if it is rumoured abroad that he has once claimed compensation. If he is past middle age he has nothing in front of him but the workhouse or an old-age pension.

These, save the mark, are some of the results of beneficent, up-to-date legislation! If these are the consequences of workmen's compensation, what shall be the result of industrial insurance? Here, again, we see the negation of freedom of contract. Employer and employed must insure. There is no option. Would the employer who was kind to Tom in the manner above suggested continue to be quite so kind after paying 6d. a week to the State in respect of Tom for 10 years? Would he not be more inclined to leave Tom to get some of his own back in the shape of disablement allowance from the State, which had intervened to modify his relations with his own servant?

This interference with freedom of contract is amongst the most illusory of the devices which are adopted to try and demonstrate that one can make the poor richer by legislation. So long as an employer is not bound to employ, and not bound to employ at a particular wage, so long can he obtain workmen at the market rate. That market rate is fixed by an inexorable law. The tendency of such a measure as the Workmen's Compensation Act must be to lower it. The actual result of the Act may be that wages have not risen as fast as they otherwise would have risen—but the result is there. As surely as this will the National Insurance Bill now before Parliament have no real and ultimate effect upon the relative wealth of employers and employed. Its only result may be to enable the employer to save that which he would otherwise spend.

Publicity and Business Getting.

At the recent Canadian Electrical Convention at Niagara Falls, some discussion took place on the advantages of publicity to the central station and on the subject of new business getting.

The author of a paper on the former subject dealt more particularly with newspaper publicity, but the remarks of subsequent speakers showed that there was a considerable diversity of opinion as to its value, more especially in small towns.

Local poster advertising found some supporters, and one speaker drew attention to the value of cartoons, which tell their story at a glance. In any case, haphazard advertising or publicity is of little real worth as compared with an intelligent methodical scheme for directing attention along the lines which pay best.

The paper on new business getting, by Mr. Kemble, sales agent of the Toronto Electric Light Co., was of considerable interest, following on the ideas we have frequently advocated in these columns.

He pointed out the great necessity for discrimination in canvassing for entering new business in order to ensure that it should be profitable. The salesman should have a thorough inside knowledge of his district and its needs—even a personal knowledge of the business men's associations and of local affairs, so that he might scent coming business and determine its prospective value.

The discussion turned largely on the payment of canvassers—a matter which has exercised the central-station engineer at home.

In the ordinary way a man will take the business which comes easiest, without regard to the electric supplier—if paid a straight commission. The author preferred to put a man on his honour and pay him a fixed salary—that was the ideal method. In the States a number of stations were trying mixed methods of paying canvassers, but as they were modifying their systems, he judged that they had not found a satisfactory one. Another system mentioned as in use in Canada was the payment of a salary and a commission varying with the class of service.

This question of the canvasser and his remuneration bristles with difficulties, as on the judgment of the "business getter" depends largely the successful progress of the year.

While he deals with the present, he must keep an eye on the future; and his efficiency will not be high unless he has some knowledge of station economics, and the lay of the mains in his district. Obviously this points to a good man, who should be good enough to receive a fixed salary; and, indeed, a logical bonus system dependent on the value of the load taken on, and such as to place a premium on the valuable consumer, seems to be almost beyond reach in practice.

Relays.

The rapidly growing use of relays—mechanical watchmen, whose function is not to perform the operation with which they are associated, but to act as sentinels and to give the order for more powerful but less intelligent mechanisms to carry it out—is a marked feature of the present time.

While it apparently introduces greater complication, it in reality makes for simplicity, for though the electrical connections necessitated become more numerous and involved, the apparatus controlled becomes less elaborate and expensive than it would be if it had to combine the whole of the watching and operating mechanism within itself. Moreover, the use of relays, far from diminishing the reliability of operation, greatly increases it, for relays nowadays are so well designed and constructed that they can be set within well-defined limits and confidently depended upon to act when called upon, whereas it is impossible to combine with the heavy operating parts of a large circuit-breaker, for example, the delicacy of adjustment necessary to ensure reliable and accurate operation under the prescribed conditions.

With the improvement of the relay itself, the ingenuity of inventors has kept pace in devising new systems of connections which confer upon the instrument powers which do not fall far short of animal intelligence—so that while it ignores all those phenomena, no matter how powerful, which it is meant to ignore, it unerringly picks out that particular combination of circumstances under which it is its duty to act.

The little relay has established itself as the ever-wakeful watchman controlling the operation of the most powerful generating and transmitting systems, and must be regarded as a factor of the first importance to their successful operation. The article, therefore, which we conclude in this issue—contributed by Mr. Kenelm Edgcumbe, an expert in the subject—should prove interesting and helpful to our readers, and we cordially commend it to their notice.

THE SWISS TOUR OF THE INSTITUTION OF MECHANICAL ENGINEERS.

By OUR SPECIAL COMMISSIONER.

As the object of this tour was to visit the great water-power electricity generating stations in the North of Switzerland, it has been of quite as much interest to electrical as to mechanical engineers. In fact, hydraulic and electric works are no longer considered as other than two special branches of mechanical engineering. They have much in common in their theoretical purely scientific development; and in these Swiss generating plants they are found close hand in hand, each essentially dependent upon the other.

On Saturday, July 22nd, we started from London in cheerful mood, because a temperature of 62° had been rumoured to exist in Switzerland. On reaching Basle, however, it almost seemed as if some confusion had arisen between 62° F. and 62° C.; and one portion of the Institution took refuge in the waters of the Rhine, swimming down stream attended by rescue boats, while another party sought fresh air by tram-riding to the foot-hills beyond the city, and climbing to the top of Chrieshone, where a splendid panoramic view of distant mountain and forest, along with cool breezes and clear atmosphere, rewarded their enterprise. Those who reached Basle early were enabled to visit the City electricity works. The old water works of Basle are described in the issues of October 3rd and 10th, 1896, of the *Schweizerische Bauzeitung*. In fig. 1 we give an illustration of the most recent addition to the steam-power plant, namely, a turbo-generator of 2,000 KW. at 1,500 R.P.M., by Sulzer Bros. Great extensions of the water-power electric plant are now nearly complete. Ten kilometres above Basle, between the towns of Augst and Wyhlen on the south and north side of the Rhine, the river is completely dammed, giving a gross fall of from 5 to 8½ m., with mean 6·7 m., to 10 Francis turbines of 15,000 H.P. total on the south or Swiss side, and to other 10 turbines on the German side yielding about the same total horse-power. The turbines are direct couped to three-phase 1,600-K.V.A. generators on horizontal shafts with periodicity 50, and speed 107 R.P.M. From the south side the energy is taken to Basle at 7,000 volts, that is, without transformation. On the north side part of it is raised to 45,000 volts, and transmitted over six aerial lines, while other four lines transmit the rest without transformation. This is the most thoroughly modern plant in this immediate district, and it seems a pity that it should have been left out of the regular programme of the Institution tour and relegated to a back page as an extra to be taken by those who could find the time for it by hook or by crook. Some of the party visiting Rheinfelden on Monday, however, were clever enough to double back upon Wyhlen, and thus to visit one-half of this double station. One special feature of the total design is that the switchboard is placed in a separate building communicating with the power house by a bridge over the supply canal, across which bridge are carried the main cables.

The orthodox programme was commenced on Monday morning under a still blazing sun, and through dense hosts of big horse-flies, which drew blood from many a wounded and irate member of the Institution. One party drove to the Rheinfelden works, some 17 km. above Basle, while another reached the same point by train. We were received and conducted over these works and the Laufenburg works, 20 km. further up the river, by the very courteous vice-Director, Herr Otto Albrecht. The Rheinfelden dam has several sluice-gates in the river part, while the head of the supply canal is without gates, but is protected by an obliquely-set grating to keep back flotsam and ice. Next to the supply canal, whose breadth is 50 metres, is a wide walled canal for the down-passage of timber rafts, and several fish ladders are provided. At the turbine house the entrance to the 20 wheel pits is protected by a fine-mesh screen, for the periodical cleaning of which a specially designed machine is erected which travels on rails along the whole length of the power house. Here also are provided sluice-gates, one between the canal and each wheel pit. We were unable to see anything of the turbines, which are vertical-shaft Francis machines, each of four runners, because they were all wholly submerged in water. The generators, direct-coupled on the vertical shafts, run at 55 R.P.M., and yield a total of nearly 17,000 H.P. The governing is effected by the usual servo-motors with oil at 25 kg/cm^2 pressure as working fluid. Twelve of the machines give continuous current at from 50 to 155 volts to various aluminium and other chemical works; and the other eight supply three-phase current at 6,800 volts for power purposes. In a separate house on the opposite side of the supply canal is placed a steam power reserve with two Brown-Boveri-Parsons turbo-generators of 1,400 and 2,400-KW. power, with condensing plant, so that only the make-up for the boilers requires to be taken direct from the river. Although the Rhine water is rather hard, no water-softening plant is used here for this make-up; but in the more modern plant at Wyhlen above-mentioned, it is interesting to note that it has been found advisable to add a water softener. The hardness of the Rhine water is from 7 to 8 per 1,000.

This station is connected to the works at Beznau, from which it has for some years taken a supply of about 5,000 H.P., as well as taking a considerable quantity from the other generating station at Wangen; both of these stations will be referred to later.

After luncheon, the party proceeded to visit the Laufenberg works, 21 km. further up the river. Here 50,000 H.P. are developed from 10 Francis turbines running at 107 R.P.M., each direct-coupled to a 5,200-KW. three-phase generator. There are here no modern features demanding description in these pages.

One party of the members devoted Monday afternoon to inspection of the Brown-Boveri works at Baden and to listening to an exposition, illustrated by lantern slides, of the general method and organisation of work adopted in these famous works by Mr. Eric Brown, who is as familiar with the English language as with German. These Baden works employ over 3,000 workmen, besides a staff 700 strong, and the capital invested is 28 million francs. Affiliated works, each with its own independent capital and financial responsibility, have in recent years been established at Mannheim, Paris, Milan, Christiania, London, Vienna, Budapest and Rotterdam. Of these the first-mentioned was the earliest offshoot, and is at present the most important as regards bulk of manufacture turned out. In all these works the total employment aggregates over 10,000 hands. Besides steam turbines, dynamos, motors and transformers, the firm does a large business in air compressors, mine ventilators electrically driven, and in electrical plant for metallurgical works and for the textile and paper industries. One of the two systems adopted for driving the extraction ventilating plant has special electric interest. A steam turbine drives a shaft on which are mounted in tandem an alternator and a D.C. generator, which is connected to a D.C. motor according to the Leonard system. Rapid variations of load are thrown back upon the boilers, which really act as the fly-wheel reserve of the system, and the result is a reduction of the number of machines needed for a given mine, and of capital and maintenance costs, as well as a valuable clearance of space occupied. In the Brown, Boveri works at Baden, one notices that the driving of machine tools each by its own motor is not carried so far as in some other modern Continental works, one motor usually driving a countershaft which serves a whole line of machines. This is probably because the great bulk of the machine tools are of comparatively small size, a large lathe and a large boring machine for the rotors and cylinders of steam turbines being the most noteworthy tools of extra size. These and other of the larger size of tool have each its own separate motor. From the scientific engineering point of view the world owes most to the firm in respect of its development of the combined impulse and Parsons type of turbine, of which it is needless to say anything here, and in respect of its perfecting of the Déri single-phase motor. This seemed rather a hopeless machine for some years after the date of its birth in the brain of the inventor, but in the hands of Brown, Boveri it has finally become a thoroughly practical motor of great utility. It excels all others in

simplicity of construction, and therefore in low costs of manufacture and of maintenance. It is extremely compact in outside form, and although its weight per H.P. is greater, the extra weight is in dead material, the quantity of copper being less. It is made in two forms, single and double. The objection sometimes raised to the single machine is that at times it draws power very unequally from the collectors on a three-phase system feeding it. In the double machine a compensation acts so as always to equalise the draft from the three collectors. The rotors of the two single-phase motors are mounted on the same shaft, while the two stators, although built together mechanically, are not magnetically connected. The special advantages of the Déri motor are

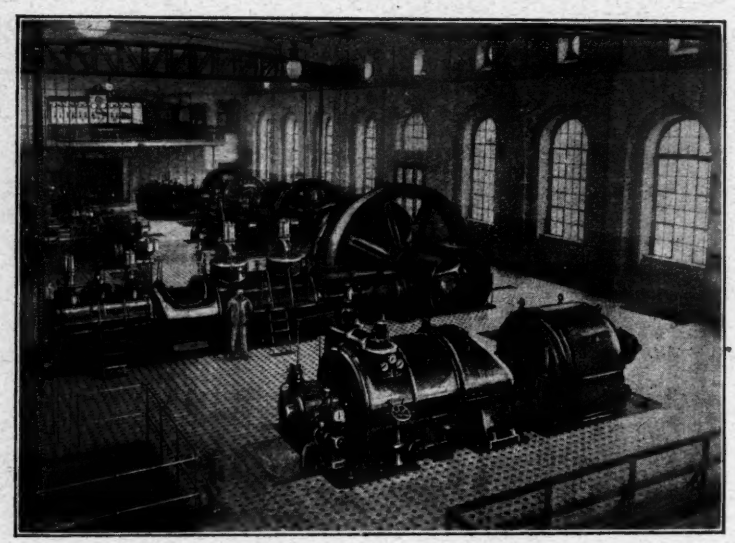


Fig. 1.—Sulzer 2,000-kw. Turbo-Generator at Basle Electricity Works.

Fig. 3.—Rotor of 1,000-h.p. Francis Turbine, Showing Corrosion of Blades.

well known; large initial torque in starting, with rapid decrease as the speed rises from zero, large overload capacity, extra low pressure in the rotor, recuperation of energy in braking, and, above all, quick and powerful regulation, as well as reversal, by simple shifting of the brushes. Fig. 2 represents one of these duplex balanced Déri motors as now being made. Several hundreds of these are now at work, and the manufacture in several standard sizes is proceeding briskly.

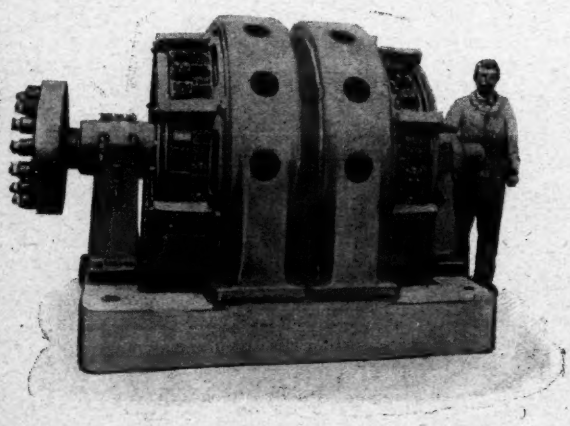


Fig. 2.—Duplex Deri Three-Phase Motor.

On Monday evening President Ellington entertained a large number of English and Swiss engineers to dinner at the Baur au Lac Hotel in Zurich. This was perhaps the most delightful and interesting episode in the whole week's programme. Here we were given the opportunity of making personal acquaintance in free and easy style with the great intellects which have in so short a period of years raised Switzerland to the first rank of mechanical and electrical engineering skill and efficiency, and of vigorous, perfectly organised commercial prosperity. It was a most exhilarating and educative contact, and one which those privileged to take part in it will not soon forget.

On Tuesday morning at 10 o'clock, the Institution meetings for the reading of papers were begun by a short address of welcome by Herr Sulzer-Ziegler, Vice-President of the Verein Schweizerischer Maschinen-Industrieller, to which President E. B. Ellington replied in brief and graceful terms. Papers upon "Swiss Electric Traction," by Herr Huber-Stockar, of Zürich, and upon "Rack-Railway Locomotives on Swiss Mountain Railways," by Herren T. Weber and S. Abt, of Winterthur, were first read. These were discussed by Dr. E. Hopkinson, in English, and by Prof. Wyssling, in German. Dr. Hopkinson attributed the recent extensions of electric traction (1) to the greatly reduced cost of generators and motors; (2) to the use of transformers; and (3) to the use of three-phase power. Prof. Wyssling emphasised the importance of commercial economy, of traffic conditions, and of the cost of coal. At present all Swiss electric traction on railways is privately owned. No State railway has yet been electrified, but a Government Commission is studying the question whether electrification backed by water-power is not cheaper than the present steam locomotive traction. The answer will be—Yes, until England sends coal to Switzerland at lower prices. The Lötschberg marks the beginning of the extension of electrification of long lines. Mr. Patchell then spoke, in English, illustrating by the figures 25·9 and 58 watt-hours per ton-mile the influence of stops, the former figure being for a certain line without intermediate stops and the latter for the same with four stops. He also asked for further information as regards construction costs in Switzerland, contrasting the high costs of water-power plants with those of steam and Diesel engines. The discussion was finished by Dr. T. Weber in German, who pointed out the necessity for high-grade workmanship throughout, and especially for more than ample braking power upon rack railways.

Herr Huber-Stockar's paper is a long one, profusely illustrated by photographs and drawings, and contains seven lengthy tables giving very full details of all the Swiss lines, including the total and analysed costs of construction, total operating expenses, and total traffic receipts. It includes also a map showing the total railway system of the country and the small part of it now electrified.

Herr F. Schubeler's paper on "Modern Diesel Oil Engines" was the next read. Herr Sulzer-Ziegler took part in the discussion of this paper, speaking in German; pointed out that 2,000 H.P. in four-cylinder engines had now been reached, and that a two-stroke cycle with 80 per

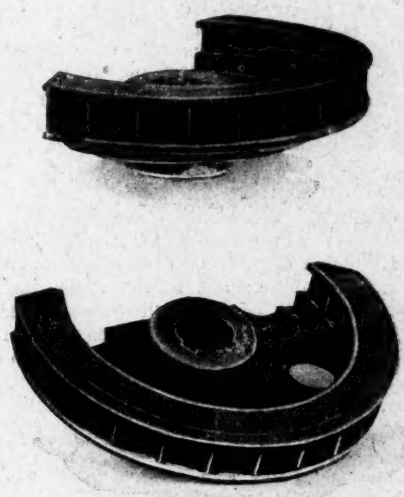
cent. efficiency was now possible, as compared with the four-stroke cycle with 95 per cent. efficiency. Experimental engines were now at work on steamers on Lake Zürich and on the Adriatic ; and engines of 1,000 and even 2,000 H.P. per cylinder were quite probable in the near future. Prof. Constam, director of the Fuel Laboratory of the Polytechnikum, speaking also in German, mentioned that experiments were now proceeding on the use of tar-oils in Diesel engines. Tuesday's forenoon meeting finished with a demonstration of Dr. Amsler's two new forms of transmission dynamometer. One of these is based on the optical measurement of the small angle of twist of a square transmitting shaft; in the other the central boss and the outside pulley of a transmitting gear transmit the torque from one to the other through four small oil cylinder-and-plunger couplings laid circumferentially, the oil pressure being measured and recorded upon a clock-driven drum. The workmanship of the dynamometers exhibited was of a specially high grade.

It may be convenient here to continue our report of the meetings at the Polytechnikum, which were renewed on Wednesday morning at 9.30. The first paper read was upon "High-Pressure Water-Power Works," by Mr. Zodel, the managing director of Escher, Wyss & Co. This was illustrated by a great many lantern pictures upon a large-sized screen. The most remarkable plants yet erected are those in Mexico, and to English eyes and ears, the descriptions of these are indeed astonishing. The paper also supplies descriptions and particulars of the Tyssedalen 33,600-H.P. station in Norway, the net head being 1,260 ft., and the turbines Escher, Wyss Pelton wheels; and of the Brusio power station on the Swiss-Italian frontier, where the total available head is 3,280 ft., which is utilised in two stages of 1,970 and 1,375 ft., as well as of several other European plants. Interesting particulars and photographic illustrations of the failure of an ill-laid-out pipe line near Cannes were given. This paper is a valuable contribution to our knowledge of water-power works, and should be referred to by engineers who wish to have the latest information on this subject.

The last remark applies equally to the next paper read, although it is a very short one—namely, that on "Results of Experiments with Francis Turbines and Tangential (Pelton) Turbines," by Prof. Dr. Franz Prásil, who is recognised as the leading Swiss expert in hydraulic measurement. The diagrams and tables of this paper show to how high a grade of efficiency these machines have now attained, and especially how this high-grade efficiency of over 80 per cent. is maintained throughout a long range of load—namely, from quarter or one-third load up to 25 per cent. overload.

The last paper was read by Herr Zoelly upon "Steam Turbines." This paper is partly theoretical, but mainly a description of the Zoelly turbine as now made by Escher, Wyss & Co. At 3,000 R.P.M. eight stages are used ; at 1,500 R.P.M. 12 stages are used ; and as many as 16 stages at 1,000 R.P.M. In the discussion of this paper, Prof. Stodola spoke for the first time during the meetings. His opinion is that the principles on which steam-turbine calculations are to be made are now well established, and that many of the earlier troubles were due to wrong choice of materials of construction, such as nickel-steel. He admits, however, that while the action of the steam in the stationary nozzles is quite certainly known, its action in the running blades is almost entirely unknown ; and this seems hardly consistent with the proposition that the basic principles of steam-turbine action are now fully established. The knowledge vacuum comes in when it is attempted to evaluate all the effects of centrifugal forces on the concave and convex sides of the blades. Prof. Stodola also spoke of the critical speed, and of the damping of the amplitude of vibration of a shaft running in water at or over critical speed. He said that the most recent experiments confirm theoretical calculations as to the elastic yield of disks at very high rotary speeds, and also referred to an important new Sulzer steam-turbine governor in the form of a small centrifugal pump. He predicted that gas turbines would become practicable when a material was found which would permanently retain its elastic qualities at 800° C. temperature. He concluded with a complimentary reference to the Humphrey gas-explosion pump, and a very handsome acknowledgment that the steam turbine would not have existed to-day had it not been for the energy and enterprise of Parsons. Several other gentlemen took part in this discussion, which closed the Zürich meetings so far as the reading of papers was concerned.

On Tuesday afternoon two parties made visits respectively to Messrs. Escher, Wyss & Co.'s works, on the outskirts of the town of Zürich, and to the Oerlikon works, three miles north of Zürich. The limits of this article will not permit any description of these works in it, but we will in a future issue give notes upon the recent modern developments that have taken place in them. Messrs. Zodel and Zoelly themselves conducted the party to their works in very kind and



FIGS. 4 AND 5.—BREAKAGES IN A GIRARD TURBINE DUE TO A CURIOUS ACCIDENT.

courteous fashion, and put a fine finish to their hospitality by entertaining the whole company to afternoon tea in the gardens of the Ton-Halle, on the borders of Lake Zürich, whence we enjoyed the magnificent view of the wooded hills bordering each side of the valley and of the grand distant snow-clad mountain ranges, at the same time listening, as far as engineering conversation permitted, to the excellent music of the Ton-Halle orchestra. The reception at the Oerlikon Works was equally friendly and hospitable, this party taking tea in the works restaurant itself.

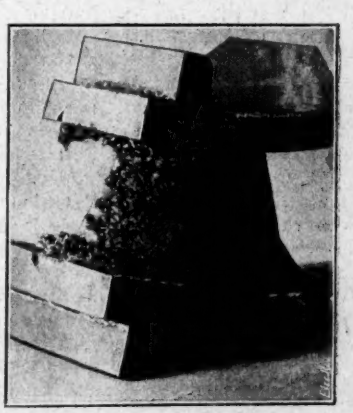


FIG. 6.—CORRODED BLADE OF TURBINE.

We may here mention an interesting item of information obtained during these evening relaxations. We are indebted to Dr. Franz Prásil for the illustrations, figs. 3 to 7. Fig. 3 shows a phenomenon difficult to appreciate except by actual seeing of the parts. This is the rapid corrosion of the blades of water turbines. The life of these does not often exceed from two to three years. This applies equally to Francis and to Pelton wheels. It is proved not to be due in any degree to the scour of the rush of water, but to be entirely chemical and to consist of an oxidation

D

of the iron. In some manner not yet clearly known, the oxygen of the air in the water is separated and perhaps changed in chemical form so as to facilitate more vigorous attack on the iron. Many attempts have been made to find a remedy for this corrosion, but up to now turbine users have had to resign themselves to the necessity of renewing the runners every three years, this renewal, however, bearing an extremely minute proportion to the initial cost of the whole plant.

Figs. 4 to 7 illustrate the results of an extremely curious accident, a description of which we will reserve to our next published article.

On Monday afternoon the many ladies of the Institution party, and a good few of their male companions, spent their time in a steamboat excursion on the lake. On Wednesday afternoon the like section of our membership spent their time in viewing the very beautiful and grand Falls of the Rhine at Neuhausen, just below Schaffhausen; while we, more devoted to the acquisition of technical information, spent most time in a fatiguing inspection of the Schaffhausen Water-Power Electricity Works, which we will describe as to its newer details in a future special illustrated article. Our genial guide throughout the day was Herr Amsler, son of the inventor of the planimeter so widely known, and himself designer of the transmission dynamometers mentioned above; and at the works itself Herr Director Geiser kindly gave us full explanations. Frau Amsler showed true Swiss kindliness and courtesy in taking charge of the ladies' party. The engineers made a hurried late afternoon rush to the Schloss Laufen on the south side of the river, there imbibing unphysiological quantities of tea and lemonade, and eventually crossing by boat to the north side through the spray of the Rhine Falls. We all combined in a specially agreeable attack upon dinner at the exquisitely situated Schweizerhof Hotel, and were a merry party on our late return by train to Zürich.

Thursday's excursion was much more arduous, at least for those seriously bent upon engineering investigation, and commenced by a start at half-past eight in the morning from the Zürich main station. Everyone kept to the train as far as Netsal, a few kilometres lower down than Glarus, in the valley of the Linth.

Here the engineers left the railway, while those on pleasure bound, along with their ladies, went further up and spent the day in the Braunwald, a picturesque partly snowclad neighbourhood reached by a mountain rack railway. The others made a thorough examination of the Löntsch water-power electricity station. This is the most modern, the boldest and the most finely executed of these works yet accomplished in Switzerland. They are electrically united with the Beznau central station, and their main purpose is to support the supply going out from Beznau. Throughout the day we had the great advantage of the guidance and companionship of Herr Schenker, the chief manager of the united plants at Beznau and Löntsch. These works are so important that a special article will be devoted to describing them. Herr Schenker first took us up by the service rope railway to the Wasser Schloss, where the long water tunnel from the lake issues to the surface of the rocky mountain and effects a junction with the three great pipe lines or flumes which descend the almost precipitous cliffs, the maximum gradient being 1 in 1, or 45°. This face forms one of the lower slopes of the rugged Wiggis Mountain, and the whole scenery surrounding this bold engineering enterprise is wild and grand in the extreme. On the opposite side of the valley—the Klönthal—we look across to the precipices and the glaciers of snow beds of the Glärnisch range; and the narrow valley between these two is filled and partly blocked by the gorgeously-wooded underhills produced some 1,300 years ago by enormous landslips from both mountains. The rocky gorge down which the river Löntsch dashes is thus a very narrow one, constantly changing its direction by sudden bends, and producing the best imitation of the Scotch Highlands that Switzerland is capable of. The power house at the bottom of this valley is a model of simplicity and perfect regulation. Carriages took most of us from here (after a good lunch at the St. Fridolin Hof at Netsal) up to the Klöntaler See, a lake whose depth and water storage capacity have been enormously increased by the building of a great dam across its lower end. Here, under the shadows of the Glärnisch Gletscher, which prevented us imagining we were in the wild west of Scotland, we visited the intake to the long supply tunnel bored through 2·1 km. of solid rock; and also the overflow or spill-way tower, where, owing to the level of the lake standing only less than half a metre above the circular intake edge of the tower, one of the most beautiful water-shower effects was seen. The heat, although not so intense as down below, was still great enough to transfer very quickly the whole stock of beer, mineral waters, "most" and lemonade from the store houses of the little mountain restaurant into British interiors. We took a slightly varied route in driving down again to Glarus, where we met the Braunwald party in trying to consume a wonderfully badly-prepared dinner. Then back to Zürich by train in the evening glow.

The excursion to Beznau water-power and electricity station had been originally planned for Wednesday, but had to be abandoned for that day owing to our secretary's too generous efforts to provide an over-liberal programme; but it was too interesting a thing to miss altogether, so that a small party was made to carry it out on Friday forenoon. We made an early morning start from Zürich, and reached

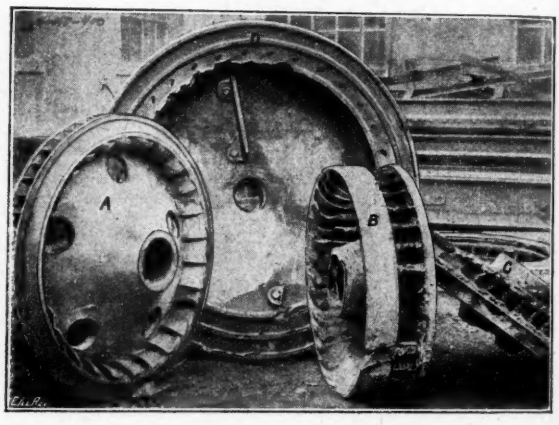


Fig. 7.—Group of Damaged Turbine Rotors.

Turgi before the sun was high. On this day, again, we were favoured by the company and explanations of Herr Schenker, and also by those of Mr. Eborall, who is well known in London. We drove from Turgi to the Beznau canal and works, and, although our time was short, we were well able to inspect the cleverly arranged power house and the specially fine switchboard, as well as the river dam, the canal intake and the tail races. We drove smartly back to Baden to enable the majority of the party, who wished to spend the afternoon in Zürich, to catch an express train; but a few of us remained in Baden to visit the Brown, Boveri works, which we could not do on Monday owing to the electro-mechanical impossibility of existing at the same moment in two widely-separated geographical positions.

The Beznau works are also so important that they require separate description in a special article.

On Friday evening those who were not dead tired with the week's proceedings attended a Cinderella dance, at the invitation of President Ellington, in the Baur-au-Lac Hotel.

By Saturday evening the whole party was widely scattered over Switzerland on long-distance excursions, to visit various interesting power works and electric and steam rack railways.

A Municipal Bowling Match.—In a bowling match in connection with Blackpool Municipal Officers' Guild, on August 3rd, the cleansing and electricity departments were in the final. The latter won by 21 to 15, and secured the first prize—a handsome rose bowl. This, and the league championship shield, have been presented by Mr. Charles Furness, electrical engineer and tramways manager, during the course of the week.

THE COMING ELECTRICAL EXHIBITION.

By A. HUGH SEABROOK.

I suppose all electrical men sincerely wish to see this Exhibition a big success.

Undoubtedly an unparalleled opportunity will be afforded of showing the electricity and gas using public what electricity can do for it, and the effect should be to make those who use a little electricity, use more, and to make those who are still using the agents of the 19th century really unhappy until they are using *the agent* of the 20th century.

I will only touch upon one direction in which the use of electricity can be greatly and profitably extended by means of the Exhibition, to the advantage of electrical manufacturers, electricity suppliers, and the general public; that is, cooking by electricity. The field for cooking is infinitely greater than that for power, vast as that is.

Viewed from the point of public health and hygiene, I do not regard the advent of the gas cooker as any advance on the old coal fire method, in fact, it is a retrogression.

The advantages of the gas cooker or boiling ring are mainly in the direction of saving time and trouble (at the expense of good health conditions) and the reduction in the public nuisance caused by the domestic coal fire chimney.

Now let us look seriously into the matter.

Are the living conditions of the *family* improved by the boiling of kettles, &c., on an unventilated open gas ring as compared with the older method of boiling on the open coal fire or closed range?

Are not the products of the combustion of gas—permeating as they do the whole house and poisoning its inmates—far more harmful than a little more smoke coming from the domestic chimney?

Can anyone claim that food cooked in *burning gas*, as in a gas cooker, is as wholesome as food cooked in a coal range?

In spite of the claims made by the gas people that gas cookers are perfectly ventilated, can you not, immediately on stepping into a house detect whether a gas cooker is in use? Even if it has been turned out for sometime there is a permanent unpleasent odour in that part of the house where gas is used.

I suppose most of us have used gas for cooking at some time or other, and it is common knowledge that my statement is correct. When we get to gas fires for warming, the position is far worse as regards impure air in rooms.

Now, what do we offer the public? A cooker which will cook as cheaply, better, and more quickly than gas, and which will not taint the food cooked or poison the air of the place where cooking is carried on; which will actually save on the butcher's bill as regards wastage and shrinkage (see Mr. Berry's conclusive evidence on this point, and I also have further confirmatory evidence), which cannot possibly cause explosions (so common with gas cookers), and which can be controlled and regulated in a more perfect manner than any other cooker—coal or gas.

Although the kitchen is cooler with gas cooking than with a coal fire, the electric cooker is by far the coolest in use of any. We know now that electricity can equal, and sometimes beat gas in cost of cooking, but is not the health point of view far more important than mere cost?

In towns there is too much impurity in the outside air, and the use of gas vitiates the inside air of our houses as well.

As I sometimes tell my consumers, when advocating electricity for everything, "it is barbarous to permit a crude chemical operation, such as combustion, to be carried on in your house; such things should be done under proper supervision and control, in properly constructed apparatus, as in an electric power house. We give you a pure and finished article, ready for immediate use, not a crude chemical product, which you have got to do a lot to before it is of any use to you. You are not a chemist, and unless you are you cannot use gas without injury to your health and that of your family."

But is not every direction in which we electricians endeavour to push our wares greatly to the public advantage? Is there any other commodity so absolutely pure, harmless, and, at the same time, universally useful and cheap as electricity? Should not our very business infuse into us a little more enthusiasm?

I admit that up to the present the public have had a larger slice of the advantages of electricity than electricians, but is it not largely due to insufficient individual enthusiasm that our increase in business turnover and profit have not been as great as they would have been had we enthusiastically and energetically marketed our commodity?

Well, let us make up for lost time, and combine to made the Exhibition the greatest success in the history of electricity.

If the manufacturer paid more attention to standardisation of his apparatus instead of quarrelling over patents, and the electric supply man were to let his costs per unit take care of themselves, and devote extra time to increasing sales, more money would be made by both. (I am so frequently taken to task myself, that I take an almost fiendish delight in getting one in on my own account.)

The most pitiable object (he would be humorous, if he were not so dangerous to the industry) is the candid *(sic)* electrical engineer, who, out of sheer lack of personal experience and knowledge, and, in spite of Dr. Fleming's statements, says that electric cooking is hopless, and can never compete with gas. I could give him any amount of proof to the contrary—*e.g.*, consumers who have had it rammed into them, often, to my knowledge, by electrical engineers—that electric cooking is costly (and, in spite of this, have adopted it), have actually queried the accuracy of the meter owing to the cost having come out so low.

The following letter came to me quite unexpectedly the other morning:—

Maida Vale, W.

The Manager,
Marylebone Electric Light Supply Co.,
York Place, Baker Street, W.

Dear Sir,—It gives me much pleasure to inform you that the electric cooker put in at my place gives me every satisfaction. It is very much cleaner than gas, and I consider that meat cooked by electricity retains its juices and flavour better than if cooked by any other method.

I have not had the cooker in long enough to let you know how the cost compares with gas, but so far as I can see there is no very great difference between electricity and gas.

I am sending this testimonial entirely unsolicited.

Yours truly.

(I enclose a copy of the original letter.)

Then we have the timorous person who writes to the technical papers and wonders what on earth he is going to do if a consumer wants a cooker at a house on the end of a small distributor. The same precious specimen would probably welcome a dozen 5-H.P. motors on the same distributor, in fact, would worry to get them, supply them at a lower price then he would a dozen cookers (a seven days' a week load—not $5\frac{1}{2}$), and happily proceed to increase his mains.

On reading the foregoing, I am afraid I have gone somewhat from the subject of the Exhibition, but what I have tried to point out is that electric cooking is reliable, cheap, and gives better results than other methods of cooking; that it is a class of load to be strenuously cultivated by supply managers, and it should be made a special feature of the Exhibition.

I have no doubt that all these points will be well emphasised at the "Tricity" stall, but it is necessary constantly to repeat and reiterate statements if they are to have any effect on the public.

I do hope that cooking will be one of the main features of the Exhibition, and I am profoundly disgusted that arrangements have not been made for the Exhibition caterers to use electricity for all their cooking during the show.

Tantalum Lamp Competition.—Messrs. Siemens Bros. Dynamo Works, Ltd., Dalston, inform us that owing to the enormous number of designs received in their competition, some delay in making the final selection is unavoidable. The work is being carried on with all possible speed. The number of designs received surpassed the firm's most sanguine expectations.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Plumbed Joint and Bonding.

In the Electrical Review of July 21st, 1911, there was published an article by me under the above title. At the time the above article was written I had not had any extended experience with Mr. Harden's system of plumbing, hence I purposely avoided any reference to the patents exploited by the Metal Jointing Co., of Adelphi House.

Recently, however, I have come upon such use of the Amalgaline joint—to wit, upon the cable system of the Metropolitan Borough of Fulham—as to cause me to modify my views very considerably, and to make me seriously consider that some of my brother mainsmen may like to know what is being adopted elsewhere. To begin with, in the Amalgaline joint, lead, and lead only, is used in the cast form.

I have seen joints at Fulham which, I am told, have been installed for upwards of five years, and all are in such a condition to-day as to make one think that finality has been reached in so far as bonding and encasing the electric portion of a joint on lead-sheathed cables is concerned. Without going into technical details of the process, which has already been described in the technical Press, suffice it to say that the quantity of metal used only approaches one-third of that required for what is generally known as the plumbed joint, whereas the time necessary to complete a joint is so small as to beggar comparison. Need I say more to demonstrate the disparity where financial reasons predominate? In conclusion, I wish to say that any mainsman interested will be well repaid by visiting Adelphi House and investigating the wonders of Adelphi Arches. I have not the smallest atom of interest either financially or otherwise in the Metal Jointing Co., Ltd.

Walter E. Rogers, A.M.I.E.E.

[The Amalgaline system was described in our issue of February 25th, 1910, when we inspected it and commented favourably upon it.—Eds. E.R.]

Battery Maintenance.

With reference to Mr. Rycroft's letter in reply to mine on the above subject, the case which drew forth my letter was not that of a new station, or even a new battery in an old one. The place has had a battery for some time, and is now enlarging it by paralleling the existing cells and putting in half the number of new ones of double the capacity. Possibly Mr. Rycroft will not think his remarks apply to such a case as this. In the case of a new station, however (and, by the way, neither of the other two cases I mentioned were new stations), I do not agree that it is right to postpone the payment of fixed charges till the future, except, perhaps, in special cases, where the future payments need be only slightly increased for a lengthy period. In the case of a battery it means comparatively large arrears paid off in a few years, and various things might happen, such as the need for a larger battery, before the agreement expires (which has actually just happened, and the original makers have got the order for the new battery, although, unless I am much mistaken, they were not the lowest tenderers, the payments to be made under the old agreement having settled the matter). This is, perhaps, a fundamental question, and not open to much argument on either side. I do not mean by this that Mr. Rycroft's letter contains no arguments, but only that it seems impossible for a continuous argument to take place, as can be the case with, say, tariff reform.

As to the shoulders upon which the expenditure falls, it is, of course, the case that, at any rate with a new station, theoretically they belong to the consumers; but in practice it is any odds that what will be affected is the amount allocated to the relief of the rates or the debit which has to be met therefrom.

With the places to which I referred, I venture (tremblingly) to be dogmatic, as it is inconceivable that the price of current would be decided by the matter under discussion.

I might also mention that I take the liberty of objecting to a matter of this sort being dealt with unknown to our grandmother the L.G.B., as I think it fairly certain that the auditors do not know anything about it, and would probably object to it if they did.

With regard to the case mentioned of a new battery being required before the expiration of the maintenance on the old one, I do not mean that the maintenance to which I object was responsible for the order going to the original makers, but only that a station may be let in for unforeseen expense in connection with storage, and therefore it is not right to postpone the payment of fixed charges. At the same time it is obvious that the greater the amount of the last maintenance payments, the greater will be the pull the maker has over his competitors.

J. S.

Ventilation and Ozone.

I read with great interest the article by Mr. Kershaw, on "Day Loads for City Power Stations," especially that portion relating to ventilation and the use of ozone.

Unfortunately, he makes no reference to the highly important subject of the impurities formed when ozone is produced by high-tension apparatus.

When using large spark coils, either for Röntgen ray photography, wireless telegraphy or connected to high-frequency apparatus for "Tesla" experiments, I have always found that not only ozone but nitric oxides are also formed, and these appear to irritate the mucous membrane, causing catarrhal affection.

Mr. Kershaw states that under the Rosenberg system, ozone is produced by a silent (sparkless?) discharge, the potential used being as low as 4,500 volts, and it would therefore be interesting to learn whether chemical analysis indicates that oxides of nitrogen are entirely absent when this process is used, and, if such is the case, whether pure ozone, when mixed with fresh air, affects the mucous membrane or produces any other ill-effect.

Ronald Grierson,
Engineer, P.C.T., Ltd.

London, W., *August 5th*, 1911.

REVIEWS.

History of the Theories of the Aether and Electricity. By E. T. Whittaker, Hon. Sc.D., F.R.S., &c. London: Longmans, Green & Co. 1910. Price 12s. 6d. net.

The above title, limited by the addition "from the age of Descartes to the close of the Nineteenth Century," sufficiently indicates the scope of this volume, but does not do justice to the fascinating subject matter. There is one very noticeable omission in the book, namely, the lack of a preface, the author contenting himself with an acknowledgment of assistance rendered in proof reading and suggestion and criticism by Mr. W. W. Rouse Ball and Prof. Orr, F.R.S. He also tenders thanks "to the Board of Trinity College, Dublin, for the financial assistance which made possible the publication of the work." Many readers will undoubtedly unite with the author in this expression of gratitude.

The volume gives a concise and connected account of the various theories which have been from time to time advanced to account for the diverse phenomena of nature in the Universe all around us, and the struggles of the human race to formulate a logical basis on which all these phenomena may be agglomerated into a homogeneous system.

The Ethnological historian can point to the rise and fall of empires and the evolution of racial characteristics in the human family, and paint an interesting and impressive picture of success and failure, but the historian who deals with the theories of cosmic action and universal phenomena has a much more impressive theme.

We see man—but a tiny molecule of the matter which goes to form the gigantic whole—casting the lead of reason into the unfathomable depths of space in an attempt to probe

its secrets; pushing his intellect outwards along the rays from a new-born sun—so far away that the figures which denote the distance pass comprehension—and bringing back evidence to confirm or refute a theory; or perchance, studying the interaction of some magnetised bodies and deducing results as far-reaching as the confines of space itself.

Such is the theme this volume deals with in a most satisfactory manner. There are 12 chapters in all, each dealing with a particular period or a particular state of theory. Thus we have the 17th century theory of the æther treated in Chapter I. In opening this chapter, the author predicates the existence of the æther and propounds the problem awaiting solution.

Then follows a general idea of the Cartesian philosophy, from whose ruins it was "that later philosophers constructed those more valid theories which have endured to our own time." Notice is given to the work of Petrus Peregrinus and Gilbert in magnetism, and of Fermat, Hooke, Newton, Galileo and Roemer in light, and to the conflicting deductions made from the various experiments.

Chapter II deals with "Electric and Magnetic Science prior to the Introduction of the Potentials," and treats of the one- and two-fluid theories and the doctrine of effluvia.

In the following chapter the rise and progress of "Galvanism from Galvani to Ohm" is considered. "The Luminiferous Medium, from Bradley to Fresnel," occupies Chapter IV, and this leads up in the following chapter to a consideration of the Aether as an Elastic Solid, bringing up the discussion of the various theories to that of Joseph Boussines (b. 1842).

Here the author halts and turns back to devote a chapter to the researches of Michael Faraday. "Among experimental philosophers," says the author, "Faraday holds by universal consent the foremost place. The memoirs in which his discoveries are enshrined will never cease to be read with admiration and delight; and future generations will preserve with an affection not less enduring the personal records and familiar letters, which recall the memory of his humble and unselfish spirit."

Chapter VII is filled with the mathematical deductions of the "Mathematical Electricians of the Middle of the Nineteenth Century," and Chapter VIII is devoted to "Maxwell," the works of his followers being dealt with in the eleventh chapter. "Conduction in Solution and Gases from Faraday to J. J. Thomson," and the "Theory of Æther and Electrons in the Closing Years of the Nineteenth Century," conclude this most interesting volume.

Throughout the book the various theories which have been propounded are given mathematically. To some the domination of mathematical formulæ will detract from the interest of the volume, while to others it will add materially to its value.

To review—in the ordinary sense of the term—such a volume as this is manifestly difficult, and the writer cannot do better than give the conclusion in the author's own words, with the remark that the volume well repays perusal:—

"By the investigations which have been recorded, the hypothesis of atomic electric charges has been, to all appearances, decisively established. But all the parts of the theory of electrons do not enjoy an equal degree of security; and in particular it is possible that the future may bring important changes in the conception of the æther.....Let this record close with the anticipation that fellowship in the pursuit of knowledge will increase in the nations the spirit of generous emulation and mutual respect."—J. D. M.

Factory Accounts. (Sixth edition.) By Garcke & Fells. London: Crosby Lockwood & Son. Price 6s. net.

This subject may either be dealt with *generally* so as to cover the procedure in all kinds of factories in which labour forms a prominent feature, or *specially* in connection with one particular industry. Furthermore, the author or authors who deal with manufacturing accounts may either be trained accountants or experts in the control of men and equipment engaged in actual production.

The book under review appears to consist of a general survey of the methods employed for controlling and keeping records in every industry mainly dependent upon labour, and the subject is dealt with from the accountant's rather than the expert's point of view.

The accounts relating to the cost of production in engineering factories—with which we are mainly concerned—have become highly specialised, and although the independent accountant must necessarily study the methods used in every manufacturing industry, the attention of those responsible for the control of engineering works may well be confined to their own special line.

As might be expected in a general survey of factory accounts, Messrs. Garcke and Fells give a number of alternative methods without any guidance as to the best procedure, whilst certain of the practice referred to without adverse comment would not be contemplated in any up-to-date machine shop. For instance, one sheet upon which a workman enters his weekly time for both day and piecework is described, apparently as a serviceable method of obtaining labour records. This plan has long since been discarded in modern establishments as being hopelessly incorrect. Again, the foreman is saddled with the custody and serving out of valuable loose tools—a system which we do not think will now be found in vogue, excepting in the smallest undertakings.

Apart from the points above-mentioned, a great deal of information is contained in "Factory Accounts," which should prove very useful to general managers of manufacturing concerns and independent accountants, but the work is lengthened and somewhat marred by the unnecessary use of long words and complex construction throughout.

Whittaker's Electrical Engineer's Pocket-Book. Edited by Kenelm Edgcumbe, M.I.E.E. London: Whittaker and Co. Price 5s. net.

This is the third edition of a pocket-book which professes "not merely to give a number of formulæ, rules and data, collected from various sources, and often of a contradictory nature, but a kind of synopsis on each subject brought thoroughly up to date."

The same lines have been followed as regards general arrangement, as in the previous editions, but advantage has been taken of the opportunity afforded by the issue of a new edition to rewrite a very large part of the whole book.

The first 100 pages deal with useful numbers, mathematics and physics, practical mechanics, and various electrical tables. The value of a collection of formulæ, &c., relating to mathematics, physics and mechanics is somewhat doubtful since such information is part of the mental equipment of men who have had a scientific training, and it is only a very exceptional man who can actually apply such formulæ to practical work without this training, and the confidence it brings. Further, the values of the power given to drive various machines on pages 64, 65 and 66, are practically useless, owing to the fact that particulars relating to depth and width of cut, and cutting speeds are not given. An error occurs at the bottom of page 64; the name of the author of the I.E.E. paper should be A. B. Chatwood. The wire tables are complete and well arranged.

The next 50 pages are devoted to the principles of magnetism and electricity. The matter given is decidedly good and concise.

Electrical measuring instruments and electric clocks, which occupy the next 50 pages, are well described, and the illustrative diagrams are clear.

Following these we have sections on lighting, secondary batteries and heavy-current resistances. The latter two articles are exceptionally good and complete, while the former is very short, a defect being that "wire" lamps are treated too briefly.

The next three sections deal with direct-current dynamos and motors, alternating-current machines and testing generators, motors and transformers. In the outline method given for designing machines the $d^2 l$ = constant × watts per rev. is recommended for finding the diameter and length of core, and the electric loading method is recommended as a check. The writer prefers the converse way, but in these days of standardisation it is really only a question of taste.

Some of the flux densities on page 247 could be materially raised without risk. The information and data given in the alternating-current section are remarkably good and correct.

Electrical transmission of power, which is treated in the next section, is very well written indeed, and, as far as we have tested, thoroughly accurate. Accuracy of formulæ is, of course, always important, but it is impossible to be too careful with those relating to transmission lines, since a serious error in the magnitude of a numerical result expressed in henries or microfarads is not at all easily detected by inspection or common sense, as, of course, it may be in other types of calculatien.

The subject of Electric Traction occupies the following 40 pages. It is, of course, an enormous subject, and a line must be drawn somewhere, but the information given on single-phase work appears to be comparatively meagre. Also the majority of footnote references are rather of the ancient history type, *i.e.*, 8 or 10 years old. No reference is made to the highly important paper recently read before the Institution of Civil Engineers on "Single-phase Electric Traction." This is a pity, since the said paper is of the nature of an authoritative treatise on the subject. Possibly, however, this section was printed before Mr. Dawson's paper was announced. The direct-current section of the article and also the part relating to the power required for driving are quite good.

The next three sections deal with the subjects of switches and switchgear, electro-metallurgy and electro-chemistry, and electric power stations and mains. The first two are brief but good. The last is necessarily more lengthy and is also good.

The book concludes with a chapter on general legal information, and a good index.

A book of this kind is a difficult one to review in a really genuine manner, and is a very difficult one to write or rather edit, since the trouble is not what to put in but what to leave out. The amount of information—good, bad and indifferent—at a technical man's command nowadays through the multiplicity of "Proceedings," &c., is almost appalling.

The book is well bound and got up, and is well worth its price, since it strikes a mean between the cheap varieties and the elaborate volumes—largely of American origin or association—which are published at a much higher price.—H.G.S.

Engineering Estimates, Costs and Accounts. (Third Edition.) By A General Manager. London: Crosby Lockwood and Son. Price 7s. 6d. net.

This work was originally published more than 20 years ago, and although the present edition has been revised to suit modern practice, some of the procedure advocated would now be considered old-fashioned. On the other hand, the principles laid down are sound and quite applicable to existing manufacturing conditions. The author appears to have had jobbing business in view throughout, as all orders are assumed to be put in hand for customers instead of for stocks.

For training the young engineer in commercial practice, this feature has some advantages, as the man who has mastered the art of estimating for jobbing and repair work will find the costing of standard products comparatively simple.

In spite of revision, the prices given for materials and finished parts are higher than obtain at the present time, whilst the charges of 50 to 70 per cent. recommended for factoring files and certain finished materials appear to be unreasonable.

In connection with methods of calculating weights some reference to the slide rule might well have been introduced, as the use of this appliance has now become almost universal for estimating purposes. Excepting as regards repairs, it is doubtful whether young engineers of the present day will ever have any use for the steam engine and boiler estimates given in Chapters XX and XXI.

The final chapter on "Costs Book-Keeping" is of a very useful character, and describes practice which should still give good results. The old-fashioned plan of allowing the men to record their own time will, however, be condemned by most up-to-date authorities.

Apart from the points mentioned above, this book is of a thoroughly practical nature, and contains matter in a readable form with which every manufacturing engineer should be familiar.

PARLIAMENTARY.

Brighton, Hove and District Railless Traction Bill.

This Bill came before a Select Committee of the House of Commons on Tuesday and Wednesday of last week, presided over by Sir Luke White.

The promoters are the Brighton, Hove and Preston United Omnibus Co., who seek powers to work their omnibuses between Kemp Town and Rottingdean by means of the railless system of electric traction. Originally, it was intended to extend the system to Worthing, but that portion of the Bill has been dropped. After hearing evidence in support of the Bill by various local representatives, Mr. Hutchinson, K.C., addressed the Committee in opposition to the proposal which, he contended, had only been introduced as a "blocking" Bill in opposition to the Hove and District Tramways Bill, which died by reason of not receiving the necessary consents. He argued that it could not be in the interests of the public that in this growing district they should for ever be saddled with a system of trackless trolleys 2½ miles long. He admitted that at present the the Brighton Corporation tramways did not run up to Kemp Town, but Brighton was extending in that direction, and there could be no doubt that in course of time the electric tramways would be taken to Kemp Town. If the present Bill were passed it would absolutely prevent the expansion of any tramway system towards Rottingdean, as the Corporation would find when they got to their boundary that the road was occupied. He contended that the railless traction system was never intended to be used permanently, but only as an adjunct to existing tramways.

After deliberating in private the Chairman announced that the Committee found the preamble of the Bill proved, subject to the work being carried out in two years instead of three as originally proposed.

Mr. Wedderburn, K.C., who appeared for the promoters, said he was quite willing to accept that clause, for it was the intention of the company to carry out the work within two years.

On Tuesday last the Bill was read a third time.

Telegraphs across Railways.—The Telegraph (Construction) Bill, which authorises the P.M.G. to carry telegraph wires across railways without payment, was reported to the House of Commons without amendment in favour of the railway companies which opposed the Bill.

Bills Advanced.—In the House of Commons, on Monday last week, the East Kent Electric Power Bill was read a second time.

In the House of Lords, on August 1st, the London County Council (Tramways and Improvements) was read a third time and passed.

In the House of Commons on Monday the Lords' amendments to the London County Council (Tramways and Improvements) Bill, were considered and agreed to. The following Bill was considered and read a third time:—London, Tilbury and Southend Railway Bill.

Electric Lamps in Mines.—At an inquest recently on the death of two men at Bryncethin Colliery, who were suffocated by an outrush of gas, some remarkable views were expressed. On the first warning of the presence of gas the workmen retired; as the work they were doing was urgently necessary, to restore ventilation which had been interrupted, they were then provided with electric lamps, and the manager, who was present, left his safety lamp 35 yards away. The mines inspector, Col. Pearson, who was present at the inquest, pointed out that the presence of men where there was gas was contrary to the regulations, and suggested that it was wrong to use electric lamps, because if they had had a safety lamp, it would have indicated danger. The Coroner, however, elicited the opinion from a witness that if they had had safety lamps there might have been an explosion. Before the accident occurred, the manager sent a man to extinguish his safety lamp, clearly showing that he was aware not only of the presence of gas, but also of the danger of using a safety lamp anywhere in the vicinity; what more could he have learnt if those so-called "safety" lamps had been used instead of the really safe electric lamps? Yet the jury said that if safety lamps had been used the deaths would not have occurred. Seeing that the object of the work was to restore ventilation, that the use of "safety" lamps would have imperilled the lives of everyone in the mine, and that the presence of gas was fully known, the rider is to us inexplicable.

TRADE STATISTICS OF JAPAN, 1910.

The following statement, showing the imports into and exports from Japan of electrical and similar goods during the year 1910, is taken from the recently issued official trade statistics; the figures for 1909 are given for purposes of comparison, and notes of any increases or decreases are added :—

	1909. Yen.	1910. Yen.	Increase or decrease. Yen.
Galvanised iron wire.—			
From Great Britain ...	61,000	59,000	— 2,000
„ Germany	1,149,000	1,979,000	+830,000
„ Belgium	24,000	75,000	+ 51,000
„ Austria	27,000	15,000	— 12,000
„ United States ...	54,000	150,000	+ 96,000
„ Other countries ...	19,000	3,000	— 16,000
Total ...	1,334,000	2,281,000	+947,000
Rails.—			
From Great Britain ...	447,000	53,000	—394,000
„ Germany	409,000	782,000	+373,000
„ Belgium	121,000	161,000	+ 40,000
„ United States ...	560,000	599,000	+ 39,000
„ Other countries ...	5,000	1,000	— 4,000
Total ...	1,542,000	1,596,000	+ 54,000
Posts for electric wire, materials for building, &c.—			
From Great Britain ...	540,000	365,000	—175,000
„ Germany	6,000	34,000	+ 28,000
„ United States ...	368,000	332,000	— 36,000
„ Other countries ...	27,000	20,000	— 7,000
Total ...	941,000	751,000	—190,000
Submarine and underground cables.—			
From Great Britain ...	199,000	1,045,000	+846,000
„ Germany	160,000	438,000	+278,000
„ United States ...	—	109,000	+109,000
„ Other countries ...	—	3,000	+ 3,000
Total ...	359,000	1,595,000	+1,236,000
Insulated electric wire.—			
From Great Britain ...	1,070,000	825,000	—245,000
„ France	40,000	35,000	— 5,000
„ Germany	210,000	403,000	+193,000
„ Italy	19,000	22,000	+ 3,000
„ United States ...	174,000	343,000	+169,000
„ Other countries ...	4,000	9,000	+ 5,000
Total ...	1,517,000	1,637,000	+120,000
Parts of electric cars.—			
From Great Britain ...	348,000	247,000	—101,000
„ Germany	86,000	113,000	+ 27,000
„ Norway	9,000	—	— 9,000
„ United States ...	685,000	464,000	—221,000
Total ...	1,128,000	824,000	—304,000
Steam engines.—			
From Great Britain ...	580,000	397,000	—183,000
„ Germany	47,000	14,000	— 33,000
„ Belgium	1,000	—	— 1,000
„ United States ...	77,000	194,000	+117,000
Total ...	705,000	605,000	—100,000
Gas engines, petroleum engines and hot-air engines.—			
From Great Britain ...	297,000	448,000	+151,000
„ Germany	55,000	23,000	— 32,000
„ Belgium	1,000	7,000	+ 6,000
„ Sweden	1,000	19,000	+ 18,000
„ United States ...	29,000	19,000	— 10,000
„ France	—	5,000	+ 5,000
Total ...	383,000	521,000	+138,000
Steam turbines.—			
From Great Britain ...	38,000	62,000	+ 24,000
„ Germany	130,000	27,000	—103,000
„ Switzerland ...	—	7,000	+ 7,000
„ United States ...	64,000	50,000	— 14,000
„ Other countries ...	—	3,000	+ 3,000
Total ...	232,000	149,000	— 83,000
Steam boilers.—			
From Great Britain ...	841,000	462,000	—379,000
„ Germany	10,000	4,000	— 6,000
„ United States ...	62,000	18,000	— 44,000
Total ...	913,000	484,000	—429,000
Electrical machinery.—			
From Great Britain ...	826,000	611,000	—215,000
„ Germany	916,000	634,000	—282,000
„ Belgium	—	1,000	+ 1,000
„ Italy	8,000	26,000	+ 18,000
„ United States ...	1,249,000	902,000	—347,000
„ Other countries ...	1,000	18,000	+ 17,000
Total ...	3,000,000	2,192,000	—808,000
Caoutchouc and gutta-percha, crude.—			
From British India ...	71,000	91,000	+ 20,000
„ Straits Settlements	427,000	1,246,000	+819,000
„ Dutch India ...	318,000	142,000	—176,000
„ Great Britain ...	426,000	959,000	+533,000
„ Germany	7,000	42,000	+ 35,000
„ United States ...	154,000	246,000	+ 92,000
„ Other countries ...	62,000	316,000	+254,000
Total ...	1,465,000	3,042,000	+1,577,000

The exports of electric dynamos and electric motors from Japan in the years 1909 and 1910 were as follows :—

To China	23,000	52,000	+ 29,000
„ Kwantung Province	196,000	151,000	— 45,000
„ Corea	75,000	104,000	+ 29,000
„ Asiatic Russia ...	8,000	2,000	— 6,000
„ Philippine Islands ...	11,000	3,000	— 8,000
„ Siam	4,000	7,000	+ 3,000
„ Australia	1,000	5,000	+ 4,000
„ Other countries ...	4,000	3,000	— 1,000
Total ...	322,000	327,000	+ 5,000

Yen = 2s. 0½d.

OVERHEAD WIRES.

[FROM A LEGAL CONTRIBUTOR.]

In the course of discussions on overhead line construction it has been frequently pointed out that in erecting such wires the only thing to do is to err on the safe side as a factor of safety. On the face of it this is sound advice, but it is sounder still when one comes to consider the matter in its legal aspect; and a few notes on the subject from this point of view may not be out of place.

The "common law" on the subject may be stated to be that anyone who stretches a wire across the land of another without leave or licence, is guilty of a technical trespass. Hence again, if wires are stretched across or along a street or highway, the person who puts them in that position does so at his peril, inasmuch as the public who are using the street are entitled to be protected against falling wires. But there may be circumstances in which a man who owns land on either side of a highway has the right to stretch wires across it. In such a case he owns the surface of the "hard high road," and so long as the right of the public to pass and repass along it is not interfered with, he cannot (at common law) be prevented even by the highway authority from placing his wires, whether they be for the purposes of telephone, telegraph, or the transmission of energy.

The Legislature, however, has stepped in to prevent the use of overhead wires in such a way as to endanger the safety of the public. They can only be used in compliance with regulations made by the Board of Trade—the only exception being the case in which a man, for his own purposes, stretches wires on his own land. If, however, A wants to stretch a wire for the supply of energy across B's field, he must comply with the regulations of the Board of Trade.

Our knowledge of the liability of those whose wires fall about and injure people must, of necessity, be largely derived from a study of the law relating to tramway companies, and it may be convenient if we review some of the cases in which the liability of these bodies has been considered.

In the first place, it may be stated that by the Tramways Act, 1870, Sec. 55, which applies to every tramway company, it is provided that the promoters or lessees of a tramway (as

the case may be) shall be answerable for all accidents, damages and injuries happening through their act or default, or through the act or default of any person in their employment by reason or in consequence of any of their works or carriages, and shall save harmless all road and other authorities, companies or bodies, collectively and individually, and their officers and servants from all damages and costs in respect of such accidents, damages and injuries.

The above provision prevents a tramway company, when sued by a person who has been injured by a falling trolley wire, from raising the defence that they are protected from actions for negligence owing to the fact that they work under statutory powers. This was made clear in a number of accident cases. For instance, in Sadler *v.* South Staffordshire, &c., Steam Tramways Co., 1889 (23 Q.B.D. 17), it appeared that an accident was caused by the company's car, which ran off the line at a point where that line joined the line of another system, over which the company had running powers. It ran off the line owing to a defect in the points at the junction, but it was not clear whose duty it was to repair the points. It was held that in any event the owners of the car were liable, because their statutory powers did not authorise their running along the highway on a track which was in a defective condition. Again, in an Irish case, a tramway company was held liable for injuries caused by the worn and slippery condition of their track.

Most of the cases in the books which illustrate the liability of tramway companies were decided in relation to cars drawn by horses, but the same principles apply in the case of electric traction. Indeed, it may also be said that an electric tramway company have a greater burden imposed upon them, as the weight and speed of the cars which they use are so much greater than the weight and speed of the old-fashioned car.

It is first important to consider the position of a tramway company with regard to the highway. Under the Act of 1870 and the provisional order which has been granted to them, they obtain leave to use that portion of the road which lies between the rails and which extends to a distance of 18 in. beyond the rails at either side. This part of the road they have to keep in repair. They also obtain leave to erect posts for the support of the overhead wire which is to be suspended at such a distance above the road metal that it will not interfere with the ordinary traffic in the streets. Regulations have been issued from time to time by the Board of Trade with regard to the use of these trolley wires. It is now proposed to consider some of the more important of these regulations.

Clause XV of the Form of Regulations made by the Board of Trade and applied to overhead wires is as follows :—"The overhead conductors used in connection with the working of the tramways shall be securely attached to supports, the intervals between which shall not, except with the approval of the Board of Trade, exceed 120 ft., and they shall be in no part at a less height from the surface of the street than 17 ft., except where they pass under railway bridges." Clause XXI of these regulations provides that "efficient guard wires shall be erected and maintained at all places where telegraph or telephone wires cross above the overhead conductors of the tramways." In September, 1902, however, the Board of Trade issued the following egulation to be used in substitution for No. XXI : "If, and whenever, telegraph or telephone wires, unprotected by any permanent insulating covering, cross above, or are liable to fall upon, or to be blown on to, the electric conductors of the tramways, efficient guard-wires shall be erected and maintained at all such places." In an explanatory memorandum which is sent with this proposed clause, the Board indicate the position in which the guard-wire should be placed.

Where there is no guard wire above trolley wires, the breaking of a telephone wire may result in contact between the wires. The result may be that serious injury is caused by electric shock. In these circumstances it appears, upon the authority of a County Court judge, that responsibility does not rest with the tramway company. In Bedworth & Son *v.* The National Telephone Co., an action was brought against the company for the price of a horse killed by an electric shock. It appeared that a broken telephone wire, which fell on the horse, had short-circuited a trolley wire belonging to the South Staffordshire Tramway Co., who were joined as defendants. The judge held that the telephone company were liable, as they had been guilty of a trespass in allowing their wire to touch that of the tramway company, and he made them responsible in damages.

Owing to a number of accidents which took place at Liverpool from the entanglement of broken telephone wires with trolley wires, the National Telephone Co. brought forward a clause excluding them from liability in such cases unless it was proved that the escape of electricity was due to the fault of the telephone company. A clause of this kind appeared in the Tyneside Bill of 1901, and a number of others. (See the Electrical Review, August 23rd, 1901, page 330).

In America it was held that where one defendant's wire carrying a dangerous current crossed the other defendant's wire carrying a harmless current, and there was no guard between them, both defendants might be found guilty of negligence, where an accident occurred owing to a contact of the wires (Rowe *v.* N.Y. and N.J. Telegraph Co. (1901) N.J. 48 At. 1 Rep. 523) ; but it was otherwise where the contact was caused by the fault of the owners of the dangerous wire, or where it was due to the fault of the owners of the harmless wire in suffering it to get out of repair (Western Union Telegraph Co. *v.* Thorn, 1894, 64 Fed. Rep. 287).

The question whether the person who sustains injury can be guilty of contributory negligence which will relieve the tramway company, does not appear to have been decided in the English Courts. It is submitted that if a passenger on the roof of a double-decker were to deliberately grasp a naked trolley wire, or otherwise expose himself to danger in contravention of the notices and by-laws of the company, and he could be found guilty of such contributory negligence, then the tramway company could be relieved. At any rate, the decisions of American Courts could be cited in support of such an argument. In Freeman *v.* Brooklyn Heights Railroad Co., 1900 (66 N.Y.S., 1,052), a company was held not to be liable when its guard wire had become charged, and injured a boy who was walking on the girder of a bridge, where he had no business to be, although it was the custom of boys so to walk. There is no contributory negligence, however, if the injured person is under duty to be where he is at the time of the accident, or where a wire is dangerously near a public passage, although the injury is caused by an unusual act on the part of a passer-by.

In addition to the liabilities which they incur to members of the public who may be injured, the company are subject to penalties if they fail to observe the by-laws already considered. It is provided that the promoters or any person or company using electrical power on the tramway contrary to any of the above regulations are, for every such offence, subject to a penalty not exceeding £10, and also, in the case of a continuing offence, to a further penalty not exceeding £5 for every day during which such offence continues after conviction thereof.

Electricity in a Textile Mill.—The electrical equipment of the works of Messrs. Mark Fletcher & Sons, Ltd., Pendleton, bleachers, dyers and finishers, has recently been completed. Electricity is purchased from the Salford Corporation, the supply being direct current at 440 volts. Approximately 165 H.P. of motors have been installed, varying in size from 10 H.P. to 50 H.P. The motors were manufactured by the Lancashire Dynamo Co., and the starters by Messrs. Royce, Ltd. The contract was carried out by Mr. Bertram Thomas to the specification of Messrs. Lacey & Sillar.

Trade with Brazil.—The Brazilian sub-section of the London Chamber of Commerce has presented a petition to the Brazilian Minister, pointing out that there is a growing practice of undervaluing and misdescribing, by means of fictitious invoices, merchandise and machinery shipped to Brazilian ports, to the detriment of honest traders and of the Brazilian revenues, and urging that steps be taken to repress the practice complained of.

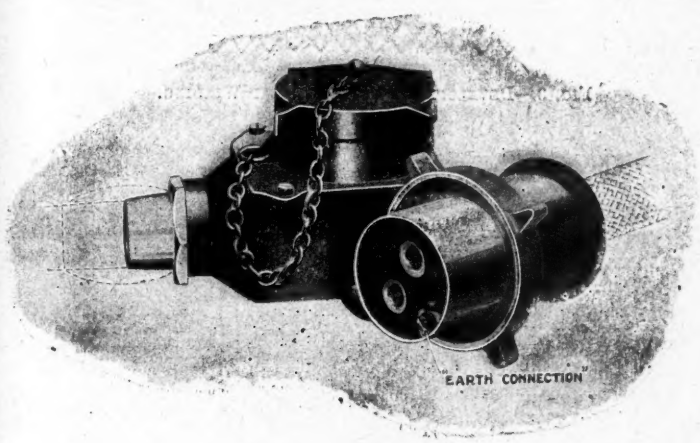
NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

A Large Electric Sign.

The Franco-British Electrical Co., Ltd., of 50, Oxford Street, W., have recently completed a large electric sign with their patent Franco letters at the premises of the Viennese Syndicate, Ltd., in Oxford Street. The sign consists of several lines of words; in the top two sets there are 306 4-c.p. lamps, the letters being 24 in. high, and 24 in number. The rest of the sign consists of 18, 15, 10, and 8-in. letters, illuminated with 986 2-c.p. lamps, each consuming six watts, and the size of all the bulbs being 35 mm. The whole sign works in connection with a 4-way motor-flasher, and when the whole is alight the total consumption is 8,400 watts. The holders are of a special type, consisting of porcelain threaded to take S.E.S. lamps, the connections to the lamps being made with a simple spring and middle contact; the connection is perfectly weather-proof without rubber washers. The makers state that this is the largest sign in London of its kind.

Watertight Wall Plug.

Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, are making a strong wall plug to carry 50 amperes, for use in connection with cranes and other heavy portable machines in docks and shipyards; the plug is watertight, and is provided with an extra pin for the earth connection, which makes contact before the current-carrying pins, and breaks after them; the design is therefore in accordance with the Home Office regulations for the earthing of portable apparatus.



Reyrolle Wall Plug.

LAP AND WAVE WINDINGS FOR DIRECT-CURRENT ARMATURES.

By Robert Rankin, B.Sc.

The subject of armature windings is ever a puzzling one to anyone first tackling it, so much so, in fact, that it may safely be said that the majority of electrical engineers never really master the elements of the theory of windings. Many have often applied the well-known rules for the ordinary lap and wave types of winding, although they would have some difficulty in proving, without an actual trial, that those rules will give a practical result. Very little assistance will be obtained by a reference to most text-books, as the most puzzling part is usually passed over with a remark that from the nature of the winding the following rules hold, or something to that effect.

The following notes show how the properties of lap and wave windings may be demonstrated, and how it may be proved, without reference to anything other than a simple diagram exhibiting the conductors arranged and numbered consecutively, that the usual formulæ for simple windings of the kind mentioned are correct. The notes may prove of assistance to some who have experienced a difficulty in grasping the fundamental ideas involved in the theory of drum windings.

In the connecting-up of an armature as a lap-wound or as a wave-wound one, it is essential that any given bar should be connected to another bar which has induced in it an electromotive force which, relatively to the armature, is opposite in direction to the electromotive force induced in the given bar. That is to say, if the given bar is under the influence of a North Pole, the one it is connected to must be under the influence of a South Pole. It will, therefore, be convenient to connect together bars similarly situated under dissimilar poles, that is, bars distant about a pole pitch from each other. In a lap winding a forward step is taken in one direction round the armature, and then a backward step, and in order that the winding may be closed and all the bars included in it, the last backward step must return to the bar from which a start was made, so that in one complete journey round the armature all the conductors have been picked up.

In the case of a wave winding all the steps are in one direction, and a journey round the armature must end approximately at the bar from which a start was made, in order to fulfil the condition that the electromotive forces in bars connected together shall be in opposite directions relatively to the armature.

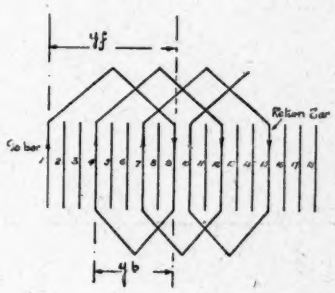


Fig. 1.—Lap Winding.

The winding rules are that, in a lap winding, the number of conductors must be even, and the back and front pitches must be odd and differ by two; and, in a wave winding, the number of conductors must be even, and the pitches must both be odd, although they may be equal. In symbols:—

$$Lap\ Y_1 = \frac{z \pm b}{2p} + 1\ ;\ Y_2 = \frac{z \pm b}{2p} - 1.$$

$$Wave\ Y_1 + Y_2 = Y = \frac{z \pm 2}{p}.$$

Where p = number of pairs of poles,
z = total number of bars on the armature.
Y_1 and Y_2 are back and front pitches.

Denoting the pitches by Y_f and Y_b, where Y_f denotes front pitch, and Y_b denotes back pitch, the reasons for the foregoing rules will be evident from the following discussion, in which bars running from back to front are called go-bars, and those running from front to back are called return-bars. The figures have been drawn with impossible pitches in order to exhibit the errors which are caused thereby.

Case of Lap Winding:—

The number of bars between two consecutive go-bars = $Y_f - Y_b - 1$, and similarly the number of bars between two consecutive return-bars = $Y_f - Y_b - 1$.

Since the steps are chosen unequal in order that continual progress may be made round the armature, and since after every pair of steps an advance is made, it is evident that there can only be one return bar between any two consecutive go-bars. Hence, as may be seen by referring to fig. 1, the number of *unconnected* bars between two consecutive go-bars is $Y_f - Y_b - 2$. As all the bars must be embraced in the winding this must be equal to zero, and therefore $Y_f - Y_b = 2$, that is, the pitches must differ by 2. Hence

the pitches must either be both even or both odd. If they are both even the go-bar will coincide with a return bar, when $Y_f/2$ back steps have been made, and the winding will be prematurely closed. This means that the pitches cannot both be even, and, since they must differ by 2, they must both be odd. The forward pitch being odd goes to an even number; the back pitch being odd returns to an odd number, and this goes on all round the armature, so that the forward pitch *always* goes to an even number and the back pitch *always* goes to an odd number, that is, if the starting bar is called No. 1. Hence the go-bars are all numbered odd, and the return bars are all numbered even, so that go and return bars occur alternately round the armature. Since the winding must be closed the last return bar must be connected to No. 1, which is a go-bar, and, since go and return bars alternate round the armature, and return bars are all numbered even, the bar adjacent to No. 1 must be even, that is, the total number of bars in the armature must be even. As already mentioned the pitches Y_f and Y_p should be approximately equal to the pole pitch, and therefore Y_f and $Y_b = \frac{z}{2p}$ approximately. $\frac{z}{2p}$ may not be a whole number, and therefore an even number must be added to or subtracted from the numerator z to make the numerator an even multiple of $2p$, and Y_f and Y_b are made equal to $\frac{z \pm b}{2p} + 1$ and $\frac{z \pm b}{2p} - 1$ respectively.

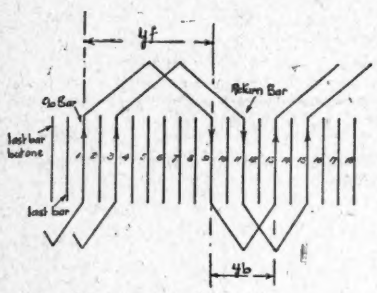


Fig. 2.—Wave Winding.

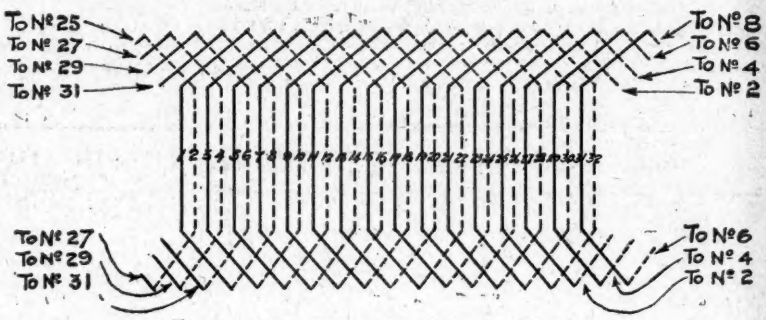


Fig. 3.—Development of 4-Pole Lap Winding.

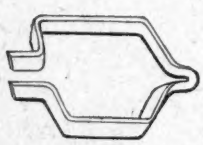


Fig. 4.

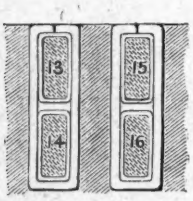


Fig. 5.

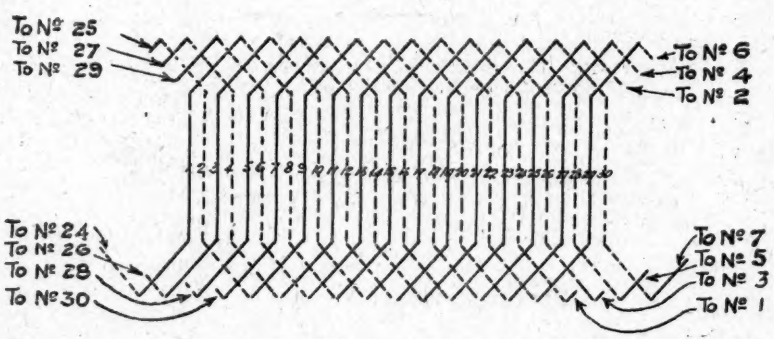


Fig. 6.—Development of 4-Pole Wave Winding.

Case of Wave Winding:—

In this case a complete journey must finish up approximately at bar No. 1, the starting point. If a return were made to No. 1 the winding would be closed in one journey. From the following it will be seen that, if a return were made to No. 2, or to the last bar, that is the one adjacent to No. 1, the winding would also be prematurely closed. Consider the return to 2. Whatever the value of Y_b, the winding would be closed to an already used bar when Y_b (or Y_f, if Y_f is less than Y_b) journeys had been made, a go or return-bar being connected in opposition to a go or return-bar already used. A similar remark would apply in the case of a return being made to the last bar. The next most favourably situated bar is No. 3, or the last bar but one.

Consider connection to No. 3. If Y_b were even, a go-bar would be connected to one already used when $Y_b/2$ journeys had been made. Hence Y_b cannot be even. If Y_f were even, connection would be made in a similar manner when $Y_f/2$ journeys had been made. Hence Y_f cannot be even. Both pitches must therefore be odd. Similar reasoning would hold if connection were made to the last bar but one instead of to No. 3.

A start being made at bar No. 1, and a return being made to No. 3, the pitches Y_f and Y_b both being odd, it is clear that all go-bars will be odd, and all return bars even. Also, the last return-bar of the first journey is to be connected to bar No. 3, the span between them being Y_f, which is odd. The number of bars between the last return-bar of the first journey round the armature and bar No. 1 is obtained by deducting 3 from Y_f, and this number must be even, since Y_f is odd. Hence, since the last return-bar must be numbered even, it follows that the bar next to bar No. 1 is also even—that is, the total number of bars on the armatures is even.

Evidently Y_b and Y_f may be equal without violating any of the conditions of winding. Hence Y_f and Y_b must both be odd, and z must be even.

Let $Y_f + Y_b = y$.

Then $p \times Y = z + 2$, since a return should be made to bar No. 3, or the last bar but one.

And therefore $Y = \frac{z + 2}{p} = Y_f + Y_b$.

Fig. 3 shows a proper development of a four-pole lap winding with 32 conductors. The pitches are $9 = \frac{32}{4} + 1$ and $7 = \frac{32}{4} - 1$.

Obviously the arrangement of bars shown in the figure is not a satisfactory one, as it simply consists in laying the bars side by side on the surface of the armature. In practice, of course, the bars are let into slots cut in the armature. To enable this to be done the bars forming the sides of a *coil* are bent into different planes.

Consider bars 13 and 22 in fig. 3. If the end connections are properly bent, a coil of the shape shown in fig. 4 is the result. All the pairs being arranged in this way, the bars shown full in the figure will be further from the centre of

the armature than those shown dotted, and the slots being made in the armature slightly greater in depth than two bars on edge together, the top or full bar of each pair may be put in a slot with the bottom or dotted bar of another pair. This is equivalent to moving the full bars in fig. 3 relatively to the dotted bars by the pitch of the bars, and the resulting arrangement in the slots is as shown in fig. 5, top bars being numbered odd and bottom bars even. Fig. 6 shows the development of a four-pole wave winding with 30 bars. The pitches here are Y_f and Y_b, where $Y_f + Y_b = \frac{30 - 2}{2} = 14$, and $Y_f = Y_b = 7$.

They are thus equal, and a return is made to the last bar but one. Remarks similar to those made in connection with the lap winding obviously apply, in this case, with reference to the actual formation of the coils and the arrangement of the bars in the slots.

BUSINESS NOTES.

Catalogues and Lists.—MESSRS. WM. GEIPEL & CO., Vulcan Works, St. Thomas Street, S.E.—Catalogue No. 811 of automatic time switches for A.C. or D.C.; the "Arbiter" type for switching on by hand and off automatically, as in restricted-hour supply, and the "Opus" type for performing both operations automatically, as in street lighting, &c. The clocks run for 35 or 16 days, and the currents controlled range up to 100 amperes.

THE BRITISH ALUMINIUM CO., LTD., 109, Queen Victoria Street, E.C.—Leaflets about aluminium bus-bars and standard forms.

THE LONDON ELECTRICAL TRADING CO., LTD., 21, Broad Street House, E.C.—List No. 4, describing the "Quartzalite" electric heating and cooking apparatus, on the Bastian patents, which work with red-hot heaters, guaranteed for four years.

THE GENEST-STOSSEL INSULATING CO., 47, Victoria Street, S.W.—Brochure describing the "Korfund" system of impregnated cork foundation plates for absorbing the vibration of machinery.

MESSRS. T. W. BROADBENT, LTD., Victoria Electrical Works, Huddersfield.—Leaflet No. 10, describing the N-type A.C. motors for one, two or three-phase circuits, from ¾ to 100 B.H.P. These motors are robustly built to withstand high temperatures, with improved rotor connections.

MESSRS. MAVOR & COULSON, LTD., 47, King Street, Mile End, Glasgow.—Card for August, showing three-phase Pick-Quick coal-cutter.

THE GLOBE ELECTRIC CO., LTD., 11, Farringdon Avenue, E.C.—List No. B56, relating to the "Supra" carbon brush-holder, a simple and efficient type which is already well known, and brushes for the same; other types of brush-holder are also listed.

MESSRS. A. REYROLLE & CO., LTD., Hebburn-on-Tyne.—Pamphlet No. 19, describing lever type motor starters, with the firm's patent resistance.

SIMPLEX CONDUITS, LTD., 116, Charing Cross Road, W.C.—Preliminary List F3 of electric light fittings in the various period styles, including some specially designed for Holophane glassware. A much more comprehensive catalogue will be issued later.

MESSRS. HASLAM & SCHONTHEIL, LTD., 11, Windsor Place, Cardiff.—Leaflet illustrating magneto and battery call telephones, particularly suitable for mines, steel works and shop work. They are ironclad and water-tight, and can be worked with one hand, being automatic in action.

THE ARMORDUCT MANUFACTURING CO., LTD., Farringdon Avenue, E.C.—Leaflet of Armorduct - "Therma" indestructible laundry and domestic irons, with testimonials from station engineers to their durability.

Consular Notes.—Russia.—The British Consul at Moscow reports that during 1910 there was a very considerable increase in Russia in the use of electrical energy, and as a consequence, of the manufacture of electrical machinery. The greatest increase in the machinery produced was shown in the output of Diesel motors, of which as many were turned out last year as during all the preceding five years. Owing to the increasing needs of municipalities, factories turning out cables, tramway and telegraph fittings, &c., extended their business, and in this connection one may refer to the signs of activity which are apparent in provincial towns such as Orel, Tamboff, Kaluga, Smolensk, Minsk, Tula and Moghileff, all of which have important municipal projects (both electrical and other) in anticipation or in progress.

In this connection, the following subsequent remarks made by the British Consul regarding British enterprise in Russia are of considerable interest:—

Hints to British Traders.—During the autumn of 1910, the British Vice-Consul at Moscow visited various important towns in the west and south of the Moscow Consular district. His tour indicated that British commercial enterprise was conspicuously lacking in the different centres where he stayed, in regard to both municipal schemes and private business. German commercial travellers were well-known visitors in the provincial towns. German price lists (drawn up in Russian) were widely distributed and this resulted in mutual knowledge between the traders of both countries, which greatly facilitated the development of German trade. Even in those districts where the strong Polish element (*e.g.*, Minsk, Moghileff) would gladly boycott goods made in Germany, it has been found impossible to exclude certain classes of German manufactures (*e.g.*, some kinds of agricultural machinery) as there is nothing to take their place. Polish agricultural syndicates would gladly purchase British-made machinery, &c., if British firms produced the goods they require or made any effort to advertise their manufactures and to get into touch with possible purchasers in those centres.

The same thing applies to British lack of enterprise in this district in general, with the exception, perhaps, of Moscow and a few other important centres. The obvious way to develop our trade relations with this country is to be found in closer intercourse between our manufacturers and possible Russian purchasers. Representatives of British firms should come out equipped with a good knowledge of Russian, with price lists drawn up in that language, and, where possible, with samples of their goods. They should personally study local conditions and requirements, ascertain how to surmount possible hindrances due to Customs and other relations, and, in general, make themselves thoroughly acquainted with the methods of business in vogue in those districts which they desire to conquer. This is what certain German firms already do, with marked success. It would probably be found very advantageous if the prices contained in catalogues, &c., were quoted for delivery at a port in Russia—say, St. Petersburg, Riga, or Libau.

Another suggestion which I would offer for the consideration of British manufacturers would be for several non-competing firms to combine for opening depôts in likely centres, by which the individual expenditure would be considerably reduced and British goods would become known and appreciated, while the firms acting in co-operation would be in a position to acquire much better and more complete information than would be available for a single firm acting alone.

The question of credit, as is well known, is another great stumbling block in the way of the success of British commerce. The long credit given by our German competitors may be impossible for British firms in the same position, but the inability of the latter to give such favourable terms must tell heavily against them.

Madeira.—The British Consul at Madeira reports that the Madeira Electric Light Co., Ltd., extended its supply in many directions during 1910. The company is substituting Diesel oil engines for its present steam plant, and the distribution will be gradually changed to the three-wire system. When this is finished the company will supply current day and night for lighting, heating and power purposes. The project for the installation of a telephone service appears to have been abandoned. The Consul feels sure that a telephone service would be a great boon in Madeira, if the charges were not too high.

China.—The British Consul at Nanking reports that the Electric Light Co., a semi-official concern formed in 1909 with native capital, commenced operations during 1910, and is now supplying light to all who desire it. The machinery, which was obtained from the United Kingdom, has proved very satisfactory, in spite of some hard usage. In this connection the Consul remarks that it may be well to mention here that it is not always advisable, when dealing with what purport to be official or semi-official concerns in China, to relax ordinary commercial precautions. The keen competition for such orders no doubt makes it necessary to allow considerably more latitude than would be granted to a private concern, but the results are rarely satisfactory.

Bankruptcy Proceedings.—WILLIAM HENRY RIDPATH (trading as Ridpath & Wells), electrical engineer, 20, Bath Street, Ilkeston, Derby.—The public examination of the above debtor took place on Wednesday last week at the Court House, 20, St. Peter's Churchyard, Derby, on accounts showing a deficiency of £1,308. In reply to questions, debtor stated that he had traded at the above address for four years, and had been aware of his position for two years. Debtor admitted that during the five weeks prior to the filing of the petition he had spent about £40 in getting about, drinking, &c. Ultimately Mr. Registrar Woodforde ordered the case to be concluded.

Liquidation.—THE HELPTOPHONE CO., LTD.—At a meeting on July 12th, it was resolved that the company be wound up voluntarily, and that Mr. R. E. Smith, of 53, New Broad Street, E.C., be appointed liquidator. A meeting of creditors was to be held yesterday.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. 47, No. 208. London: E. and F. N. Spon, Ltd.—The issue for July, 1911, contains the following papers:—"Electricity Meters and Meter Testing," by H. A. Ratcliff and A. E. Moore; "Wireless Telegraphy in Relation to Interference and Perturbation," by J. E. Taylor; "Long-distance Transmission of Electrical Energy (Reply to Discussion)," by W. T. Taylor; "The Electrical Undertaking of the Tame and Rea Drainage Board," by L. F. Mountfort; "Electric Cooking Apparatus," by Harold Gray; and "Parallel Working of Alternators," by J. R. Barr.

Les Lampes Electriques. By H. Pécheux. Paris: Gauthier-Villars.—This little book forms a part of the Encyclopédie scientifique des Aide-Mémoire, and gives a concise account of the manufacture, testing and characteristic properties of the various kinds of electric lamps. The treatment is rather scientific than popular, and occasionally academic; the illustrations in particular must be regarded as diagrammatic sketches, by no means affording

a guide to good modern practice. The matter, however, is well up to date, and brings together in convenient form a great mass of information on the subject named.

Elektrochemische Umformer (*Galvanische Elemente*). By J. Zacharias. Vienna: A. Hartleben. Price M. 4.—In this work the author first discusses the nature and development of primary cells, and proceeds to describe many of the commercial forms now in common use for various purposes, with special attention, of course, to the "dry" cell. The setting-up, testing, and connections of primary batteries, both for small current apparatus and for the more weighty applications, are fully dealt with, so recent a cell as the Benkö bein g included. The author appears unduly optimistic as to the results to be got from "earth cells," but has collected in this volume a quantity of data which should render it a valuable work of reference.

"*Proceedings* of the Engineers' Club of Philadelphia." Vol. XXVIII, No. 3. July, 1911. Philadelphia: The Club.

"The Ten Republics." By Robert P. Porter. 1911. London: George Routledge & Sons. Price 1s. net.

"Atti della Associazione Elettrotecnica Italiana." July, 1911. Milan: Stucchi, Ceretti & Co.

"Il Nuovo Cimento." July, 1911. Pisa: Tipografico Toscano.

"Corrections for the Effects of Atmospheric Conditions on Photometric Flame Standards." By W. J. A. Butterfield, J. S. Haldane and A. P. Trotter. Paper read at the meeting of the International Photometric Commission at Zürich, July, 1911. From the authors.

"Revue d'Electricité (*Bulletin* of the Société Belge d'Electriciens). Vol. XXVIII, No. 6. June, 1911. Brussels: E. Bruylant.

Trade Announcements.—General Electric Co., Ltd.—Owing to increasing trade, the Dublin branch has removed to more commodious premises at 13, Trinity Street, the new telephone number being 3300 Dublin (two lines).

Arthur Jopling & Co., 10, Westmoreland Buildings, Aldersgate Street, E.C.—This business will in future be known as "The English Electrical Co.," under new proprietorship. The firm will continue to manufacture arc lamps and act as wholesalers of electrical accessories of every description.

Messrs. Andre Citroen & Co. opened new works at Paris on the 22nd ult., equipped with the latest gear-cutting machines, made by the firm themselves.

Messrs. Galsworthy, Ltd., 15 and 16, Newman Street, Oxford Street, W., announce that owing to increasing business they have just completed very considerable extensions to their showrooms, which have also been redecorated and rearranged. The firm claim that they form one of the finest suites of showrooms for electrical fittings, containing a very complete all-round selection of models.

For Sale.—The business of Messrs. Wenham & Waters, Ltd., electrical and sanitary engineers, &c., Paragon Works, Croydon, is offered for sale by private tender. See our advertisement pages to-day.

LIGHTING and POWER NOTES.

Aldershot.—The U.D.C. has received the sanction of the L.G.B. to a loan of £2,500 for E.L. plant.

Altrincham.—The Bowdon, Hale and Timperley Councils have agreed to be represented at a conference to be held about September next, for the purpose of discussing the proposal of the Altrincham Electric Supply, Ltd., to apply for a prov. order authorising an extension of the area of its supply.

Bacup.—The Corporation has decided to apply for sanction to the borrowing of £1,250 for electricity purposes.

It has also decided to supply current for public lighting at 2d. per unit, or 18s. per 50-c.p. lamp for 2,000 hours.

Biddulph.—Mr. Robert Heath has placed before the U.D.C. particulars of the cost of the proposed E.L. scheme for the town. With overhead mains the cost will be £2,700, and the annual expenditure, with repayment of capital and interest, £607. A canvass of the town has shown 230 probable consumers, and the probable consumption is 37,800 units per annum. At a charge of 1½d. per unit this would cost £236, and retailed at 4d. or 4½d. per unit, the income, with meter rents, would give a prospective surplus of £84 per annum. The whole matter is being considered in Committee.

Clayton.—With reference to the E.L. scheme for the district, the U.D.C. has asked the Electrical Distribution of Yorkshire, Ltd., whether it is able to supply current at ¾d. to 2d. per unit for power, and not exceeding 4d. per unit for lighting, and whether current can be supplied within a year from the date of the receipt of the order.

Clevedon.—The U.D.C., on August 2nd, decided to assent to Messrs. Christy Bros. applying to the B. of T. for an extension of three months for completing the E.L. scheme.

County Durham.—The County of Durham Electric Power Supply Co. has applied to the B. of T. for consent to the use of extra high-tension transmission above ground, for the purpose of supplying energy at a pressure of 20,000 volts between the sub-station at Pease's West, Crook, to Windlestone Colliery, and from South Hetton to New Hesledon. The lines will be in the area of the Crook and Willington U.D.C.'s, and the Auckland, Sedgefield and Easington R.D.C.'s, all of which bodies have given their consent.

Crook.—The U.D.C. has accepted the tender of Messrs. Pease & Partners for installing 20 25-c.p. lamps at Sunniside, at £213, and supplying current at 35s. per lamp per annum.

Ealing.—The profits of the electricity undertaking for the past year amounted to £1,700. Freehold property in Bond Street is to be purchased for outside offices for the electricity undertaking, at a cost of £1,200. Alterations, &c., are to be carried out at an estimated amount of £500.

Egham.—The B. of T. has granted the application of the E.L. Co., which was the subject of a recent inquiry for permission to erect a generating station on the Causeway at Egham.

Epsom.—After partly considering a suggestion made by its engineer, Mr. A. C. Gilling, as to the expenditure of £3,500 upon additional power plant for the electric lighting works, the U.D.C. has deferred the matter until after the summer vacation. Mr. Gilling advocated the purchase of a Diesel engine and generator, whereby the total cost of production would be reduced and the Council would be able to supply cheap power to customers where necessary. It was estimated that the net economy effected by the Diesel installation would be £639 15s., and repayment of capital and interest would further reduce this sum to £289 15s. The Lighting Committee complimented Mr. Gilling upon the financial and technical results of the undertaking since his appointment as resident engineer.

Finchley.—At the last meeting of the Electricity Committee it was decided to instruct Mr. Ryde to appear on behalf of the Council in the appeal pending in regard to the assessment of the electricity undertaking. The appeal had been lodged owing to the assessment having been increased from £400 to £1,800, which, in the opinion of the Electricity Committee, after making comparison with the assessments of other electrical undertakings, was very high. Councillor Fry stated that the £1,800 was the sum put before the overseers by an expert valuer.

Gellygaer.—The U.D.C. has decided to substitute electricity for gas for lighting the main road from Glanymant, Pengam, to Bargoed Station.

Herne Bay.—Both the gas company and Messrs. A. E. Hunt & Sons, a local firm, have submitted terms to the U.D.C. for taking over the E.L. order. The Council has deferred discussion on the matter.

Hornsey.—The sanction of the L.G.B. has been received to a proposed loan of £9,000 for electric lighting. A strip of land at the rear of the generating station is to be purchased from the Great Northern Railway Co. for £500. The feeder cable in the Broadway is to be extended at a cost of £400.

Horwich.—A correspondent says it was announced on Tuesday, in connection with the strike of 4,000 employés at the L. & Y. Railway Co.'s locomotive works at Horwich, near Bolton, that the electric lighting of the works, institute, villas, cottage hospital, offices, and other places supplied from the works, will be stopped. The men who have worked the plant, it was stated, were to be brought out. An agreement was made with the company last Saturday to the effect that certain men should be allowed to work at the plant on condition that they should do no other work. The men alleged that that agreement had been broken, and they decided to withdraw the men.

Hull.—The trawler owners and merchants engaged in the Hull fishing district are anxious to obtain a supply of electric current for lighting and power, and have forwarded an application to the Hull Corporation to supply them. A deputation has also waited upon the Corporation Electric Light Committee, and impressed its claims upon the Committee. The North-Eastern Railway Co. has, however, to be taken into consideration as the owners of the fish dock and as the landlords of many of the applicants. The Committee hopes to arrive at an agreement satisfactory to all the parties.

Ilkley.—The U.D.C. on August 2nd decided not to entertain a proposal to take current in bulk from the proposed Wharfedale Electric Light Co.

King's Norton.—The work of providing a supply of electricity to the district has been commenced, and the order for laying mains has been given to Callender's Cable and Construction Co., Ltd. The work will be carried out under the supervision of the Birmingham authorities, under whose control the district will pass shortly.

London.—Islington.—The Lighting Committee has decided to reduce the price paid by the Council for electricity supplied for public lighting from £12,100 to £11,000. It has further decided to place £1,000 out of the surplus fund of the undertaking to the relief of the general rate.

Loughborough.—In our last issue we referred to the June statistics of the electricity undertaking, and it is only fair to state that the apparently adverse figures are explainable as to output, because there were two general holidays in the month, when, of course, the power load fell to nothing, and, as to costs, because it was necessary to run non-condensing for a week, owing to the

canal being emptied. In the preceding 12 months the monthly increased outputs, compared with the previous year, ranged from 97 per cent. to 30 per cent., and similarly a reduced cost per unit delivered was shown. It will be seen, therefore, that June was an exception to the rule.

Lytham.—Through Mr. Butterworth, a London solicitor, a private concern has informed the U.D.C. that it intends applying to the B. of T. for a prov. order for E.L.

Mansfield Woodhouse. — The Mansfield T.C. has informed the U.D.C. that it is desirous of carrying out the E.L. order which it holds for the district, and asked whether, in view of the increased population, the Council would be prepared to pay £150 a year for public lighting. The U.D.C. refused to vary the terms of the agreement already entered into.

Nelson.—At the T.C. meeting, on August 3rd, the chairman reported that the B. of T. had decided to make an order authorising the supply of electricity in bulk to Brierfield, subject to a provision that such supply should not be used for traction purposes in connection with tramways worked by the Burnley Corporation.

Newcastle-on-Tyne. — Power Supply Progress.— The Newcastle-upon-Tyne Electric Supply Co. reports a considerable increase of electric power in its area to June last. Taking the whole of the North-East Coast power systems into consideration, including the Newcastle, Durham and Cleveland companies, about 150,000 KW. was connected up to June 30th, the greater part of which is supplied by the Newcastle Co. Of this total, 66,000 KW. is used in collieries and ironstone mines in the Northumberland, Durham and Cleveland districts. Among the more important extensions lately carried out are supplies in connection with the shipyard of Messrs. Swan, Hunter and Wigham-Richardson, Ltd., which now contains a sub-station of 2,700 H.P. The sub-station has recently been extended and contains four 700-H.P. transformers, with a ratio of 5,500 to 440 volts, the low-tension switchgear being of the Reyrolle pattern. The additions are to cope with the steadily increasing demand, and there is a duplicate low-tension supply given from the Carville generating station. An important installation of electric power is being made in connection with Messrs. Armstrong, Whitworth & Co.'s new naval equipment works at Walker-on-Tyne. Here four large electrically equipped cranes are being employed, each with two 25-H.P. and one 10-H.P. motors. These cranes are situated on the river side, and are being used to swing wagons of excavated material over lighters which take "the spoil" out to sea. The contractor is also using electric power for various other operations. At the engineering works of Messrs. Donkin & Co., Walker Gate, some 200 H.P. of electrical machinery is in use, an addition having recently been made to the lathes in the heavy machine shop and telegraph shop, driven at 440 volts, three-phase. At the St. Lawrence ropery of Messrs. T. & W. Smith, Ltd., of Newcastle, 350 H.P. of electrical plant is now installed, including four rope machines of 20, 15, 12½ and 6½ H.P., and for other purposes; 75 H.P. of three-phase squirrel-cage motors running at 480 R.P.M. and 440 volts has been installed at Messrs. Carr's Saw Mills, Newcastle-upon-Tyne, to replace steam plant using saw mill refuse, previously considered one of the most economical ways of obtaining power. An installation of electric power has been made at the Ouseburn Sailcloth Factory, belonging to Messrs. Stokoe & Co., where over 50 H.P. is being used for the looms and spinning frames. In connection with the lighting in the Monkseaton district a new sub-station is being built with special architectural features to suit the surrounding residential property, which will have a capacity of 140 H.P., and will transform power from 5,500 down to 440 volts. In this connection a new cable has been laid from the Cullercoats sub-station to the Monkseaton sub-station. A new sub-station is also being built for the purpose of supplying the Burradon and Coxlodge Coal Co. at Burradon Colliery, which will have a total capacity of 1,200 H.P., containing two transformers of 600 H.P., with a ratio of 20,000 to 3,000 volts. High and low-tension switchgear of the Reyrolle ironclad pattern is being used. In connection with this and the other 20,000-volt sub-stations on the system, 12 sets of 20,000-volt electrolytic lightning arresters are being installed on the main step-up and junction switchboards of the system. These various extensions have been carried out under Messrs. Merz & McLellan, of Newcastle-upon-Tyne and Westminster, the consulting engineers to the power companies, who are also responsible for various other private, colliery and shipyard supplies.

Northallerton.—At a meeting of the Urban Council on the 3rd inst., it was decided to accept the tender of the Northallerton Electric Power Co. for street lighting for five years. It was the only tender received, and it was stated that the company offered a discount of 5 per cent. if the tender were accepted for five years. The motion that the tender should be for five years was only carried by the chairman's casting vote.

Oulton Broad.—The U.D.C. has applied to the B. of T. for permission to use overhead mains for the purpose of carrying out the E.L. order.

Peterborough.—For the year ended March 31st last, the electricity undertaking shows a net surplus of £534. Of this amount £350 is being set aside to form the nucleus of a reserve fund.

Rishton.—The directors of the Victoria Mill, Rishton, have decided to work their machinery by electricity. This will be the first mill in the district to adopt this method. There will be a separate motor for each loom.

Rochdale.—The Electricity Committee has recommended the T.C. to reduce the charge for current for private lighting from 4½d. to 4d. per unit, as from July 1st.

St. Helens.—The T.C. has decided, subject to the consent of the B. of T. and the local authority concerned, to extend the H.T. feeders from the power station to St. Helens Junction, and thence along the permanent way of the London and North-Western Railway to Earlestown, in order to supply current to the Railway Co.'s works. The company will guarantee a minimum annual consumption equal to 500 KW. for 21 years, with option to discontinue at the end of seven and 14 years, on payment of compensation to the Corporation in respect of the mains laid on the company's property. The new feeders will be available for the supply of current to the works of Messrs. Bolton & Sons, Ltd., and the Parr side of the borough.

Stockport.—For the past year the Electricity Department's income totalled £21,513, and the gross profit amounted to £10,235. A sum of £3,539 was contributed to the local rates. The tramways made a profit of £28,449 out of an income of £56,642, and contributed £7,050 in aid of local rates.

Wadebridge.—The public lighting on the Egloshayle side of the river by electricity was inaugurated on August 1st, and has given great satisfaction.

Wakefield.—At the City Council meeting held on August 1st, Councillor England, chairman of the electricity department, in referring to the previous year's work, briefly dealt with the financial position of the undertaking, which last year showed a smaller deficit than in the previous years, viz., £213. He pointed out that the total capital expenditure had been £88,863, and that since 1898 plant valued at £11,566 had been scrapped, and that the total dead capital was £15,318, against which £6,562 had been repaid, leaving £8,756 as non-revenue producing at the present time. Between the years 1905 and 1908, nearly £3,000 was withdrawn from the undertaking for the rates, which should have been available in a reserve fund. However, the prospects of the undertaking were now better, partly in view of the increased efficiency which the plant would have when the new exhaust turbines were working. He concluded by urging that the electricity department should have a fair share of the street lighting. The Wakefield electricity department is fortunate in its chairman, Mr. Harry England—the well-known manager of the local tramways undertaking.

Wath (near Barnsley).—The U.D.C. has decided to discuss in committee an application from the Electrical Distribution of Yorkshire, Ltd., for the consent of the authority to distribute electricity in its area. At a meeting of the Council it was explained that if the B. of T. granted the order the company would have power to supply the district for 42 years, at the end of which time the Council would have the right to take over the supply.

Wellingborough.—The R.D.C. has consented to the parishes of Newton Bromshold and Higham Park being deleted from the prov. order for E.L. which is being applied for by a Northampton company, but to insist on the other parishes in the district being included.

Wimbledon.—Mr. T. C. Ekin, Inspector to the L.G.B., has held an inquiry in connection with an application made by the B.C. for powers to borrow £7,459 for the extension of the Corporation's electrical undertaking to supply energy to the Maldens and Coombe districts.

Wrexham.—The L.G.B. has sanctioned the borrowing by the Council of £3,587 for electrical extensions, the majority of the loans being for terms of 10 or 15 years. The short period items are a traction battery (seven years) and meters (four years). For the reversible booster, switchgear and cables in connection with the battery 15 years are allowed. It will be recollected that the L.G.B. inquiry produced strong opposition from the local gas company, which naively suggested that the electricity concern "was going ahead too fast." Electric street lighting, for which a loan of £500 has now been sanctioned, was also strongly contested. That inquiry brought out other matters as well, for according to the newspaper reports, Mr. Ekin, the L.G.B. inspector, criticised the Council for placing its balance of net profit to reserve, rather than paying off its arrears of rate aid. As the Town Clerk explained, this revolutionary doctrine is diametrically opposed to the views of one of Mr. Ekin's more energetic colleagues, who had previously urged the Council on the course it has taken. Anyway, it is satisfactory to the Council and Mr. Pickvance, the engineer, to know that they have successfully established their case before the L.G.B.

Yarmouth.—At a recent meeting of the T.C. a report was received from the Lamps Sub-Committee as to a visit paid to Southtown Road to inspect a system of electric lighting from the tramway standards which had been installed. The Council decided to adopt the system of lighting, the lamps to be hung in anti-vibration holders. At present the road is lighted by gas

TRAMWAY and RAILWAY NOTES.

Accrington.—At the T.C. meeting last week, Ald. Higham referred to the recent tramways arbitration question, and suggested that a further letter be sent to the Haslingden Assessment Committee, pointing out that the Corporation did not disagree with the terms of the award as binding and final, but it asked that it should be amplified, and enough data given to enable it to arrive at the amount the umpire had settled. If the Committee refused, he did not know what would happen, but he had some reason to believe it would consider a letter in such terms and arrive at something like a fair understanding. The Council would see that the town clerk had submitted a case for the opinion of Mr. Ryde, K.C., one of the highest authorities on rating, as to whether the tramways assessment award complied with the terms of reference. Mr. Ryde had given his opinion that the umpire had not duly complied with the terms of reference.

Barrow-in-Furness.—The new electric tramway across Walney Island was formally opened last Friday, and during the holidays in the early part of this week it was extensively patronised and proved a boon to thousands. It links up the town with the Irish Sea, and for a mile stretches from the one side of the island to the other, the cost has been only £7,000. Alderman Smith, the chairman of the T.C. Electricity Committee, at the official opening, said the plans and scheme were got out in five or six weeks' time, and in one day short of two months from the signing of the contract the work had been accomplished.

B. of T. Railway Statistics.—A recent B. of T. Blue Book records the fact that at the end of 1910 there were 229¾ miles of railway worked partly by electricity, and 205 miles worked solely by electricity, the figures being similar to those of the preceding year. During 1910 the energy used actually for train working amounted to 236 million units, an increase of about 16 million units on the previous year. In that year the tube railways of London carried 173 million passengers, and during 1909 the total railway passengers amounted to 1,204,870,000, as compared with 2,743,189,000 tramway passengers. The corresponding 1910 results are not given.

Burnley.—The B. of T. recently recommended the trial of speed indicators on the Burnley tramcars. After the tramways manager had reported on the matter to the Tramways Committee, it was resolved that "the Board be informed that when a speed indicator is made satisfactory for bogie cars, the Corporation will consider the advisability of adopting it."

Continental Notes.—Italy.—The Italian Public Works Department has officially approved of the project of the Commune of Vicenza, to construct an electric tramway from the Porta Castello to Loggetta, and for extensions of the existing lines running to the station of the Vicenza-Schio ailway. Official sanction has likewise been accorded to the scheme for establishing an electric tramway between Napoli and Acerra.—*Giornale dei Lavori Pubblici.*

The beautiful district around Lake Maggiore in Lombardy has been made accessible by the opening on the 12th ult. of the electric rack railway from Stresa to Mottarone. This line has some important features. It starts from the bridge on the lake at Stresa, at an altitude of 97 m., and rises to Mattarone at a level of 1,379 m., thus bridging a difference of level of 1,182 m. The line is 9·86 km. long, 6·96 m. of which are on the rack system. The least radius of the curves in the natural adhesion portion of the line is 25 m. urban and 60 m. extra-urban. In the rack portion it is 70 m. The lines are equipped with 35-kg. Phœnix rails in the city portion, and 23-kg. Vignole beyond. The teeth are of Strub pattern. The system of traction adopted is continuous current at 750 volts, the return being made by the rails. The train is composed of an automotor and attached coach, capable of accommodating 110 passengers. The speed is 20 km. an hour in the natural adhesion portion of the track, and 12 km. on the rack portion.—*Ingegneria Ferroviaria.*

Russia.—It is stated that the Warsaw-Vienna Railway Co. owns a concession for the construction of an elevated electric railway between Warsaw and Grodzisk, which would be carried over the track of the railway. It is not definitely known when the directors will make use of the concession, although it is believed that the matter will be settled in October, by which time they hope that the Russian Government will give a binding declaration in regard to the continuance of the railway as a private undertaking. Should the latter question be regulated in the desired way, the company will make use of the electric railway concession by granting a sub-concession to an American firm.

A scheme for the construction of an electric railway between Krestowski-Tor (Moscow) and Ssergijew, a distance of about 45 miles, is at present under consideration.

Germany.—An electric cable railway between Erdmannsdorf and Augustusburg, Saxony, has lately been completed and opened for traffic.

France.—A new company has recently been formed in Paris, with a capital of £32,000, and the title La Compagnie des Tramways Electriques d'Eu a Ault et du Littoral, to construct and work an electric tramway between Eu and Ault, in Normandy.

Erdington (near Birmingham).—At the meeting of the U.D.C. it was reported that the time provided by the notices for receiving objections to the proposed construction of a double tramway track had now elapsed. It was decided to hold a special meeting of the Council on the 21st inst. for the purpose of accepting a tender or tenders for the work.

Haughton-le-Skerne.—The Darlington T.C. has applied to the B. of T. for a further extension of time from October 24th next for extending the electric tramways to Haughton. The order, obtained in 1902, was due to expire on July 24th, but the B. of T. extended the time to October 24th. The extension has not been carried out for financial reasons.

Lanarkshire.—The extension of the Lanarkshire Tramways from Motherwell to New Stevenston has now been officially inspected, on behalf of the B. of T., by Col. Yorke, and is open to traffic. The new line is about 1½ miles in length, and has been constructed within three months.

Leeds.—The Corporation Tramways drivers and conductors, numbering 1,000, struck work on August 3rd, and the tramway service in the city was consequently suspended. An agreement was, however, reached the next day as the result of a conference organised by Mr. G. R. Askwith, of the B. of T. In the agreement special attention has been paid to the "spread over" system of hours, which was the chief cause of dissatisfaction on the part of the men, who said that working practically 78 hours a week for 54 hours' pay was unendurable, allowing time for neither rest nor recreation. It is now agreed in the case of drivers that on all duties when the "spread" does not exceed 12 hours, there shall be a margin of three hours (a compromise between four and two), with no deduction for meal time. On all duties exceeding a 12-hour "spread" and up to 15 hours, a margin of two hours is to be allowed. On all duties exceeding a 15-hour "spread" a margin of one hour is to be allowed. When a duty exceeds 12 hours a half-hour is to be deducted for meal time. The Corporation guarantees that the percentage of "spread overs" shall not increase in future, but, so far as possible, decrease.

Leigh.—The Corporation has approached the South Lancashire Tramways Co., with a view to obtaining a 10-minutes' service between Leigh and Lowton—the company's terminus. The matter is under the consideration of the tramway authorities.

Liverpool.—Mr. C. W. Mallins has had one of the Corporation cars fitted with a modification of the present form of lifeguard affording further protection, and he has also designed a form of lifeguard for the motor-omnibuses in the Corporation's service, which are at present unprotected. The Corporation has decided, in consideration of Mr. Mallins permitting it to have the restricted right for all time of manufacturing, acquiring and using the improved tramway lifeguard and the lifeguard for the 'buses without payment of any royalty or other charges, to pay the patent fees, together with the general manager's out-of-pocket expenses in connection with designing and patenting the inventions. Two different types of lifeguard are to be fitted to two cars each.

London Suburban Railway Electrification.—At the half-yearly meeting of the Brighton Co., the chairman remarked that they had now nearly regained the whole of the traffic they lost from the advent of electric tramways in the suburban districts. The Victoria-Crystal Palace electric service had only been running since May 12th, but the results were equally satisfactory; at the end of the year when the London Bridge-Crystal Palace service was working they expected to attain even better results. The additional receipts derived from these services represented nearly 30 per cent. of the total increase in passenger receipts.

In conjunction with the above, it is worth noting that the chairman, speaking at the South-Eastern and Chatham Railway Co.'s joint meeting, said that the competition of the Brighton Co.'s electrical trains had cost them an infinitesimal sum. He did not think that the electrification of the North Kent loop lines would pay, unless as an alternative to extending Cannon Street and Charing Cross Stations. As the S.E. and Chatham directorate has relinquished its short-distance passengers to the tramways, and the outer "suburban" passengers, which it is supposed to cultivate, are fewer in number, the prospects of terminal station enlargement or electrification seem somewhat remote.

The report of the North-Western Co. refers to the progress being made with the Euston and Watford Railway, in which the laying of the permanent way and construction of stations is being taken in hand.

Malvern.—The B. of T. has confirmed the Malvern (Funicular) Light Railway Order, 1911, made by the Light Railway Commissioners.

Manchester.—A resolution not to work with non-unionists after the 31st inst. was adopted at a mass meeting of the Manchester municipal employés, at the Downing Street Co-operative Hall on Sunday. It was urged by the chairman, Councillor W. Phillips, that there was great unrest among the tramway employés of the city, and something would have to be done to remove it. Colonel J. T. Jones, the organising secretary of the Municipal Employés' Association, said they wanted a minimum wage of 26s. per week, and an eight-hours day.

Newcastle-on-Tyne.—On the 2nd inst., at a meeting of the City Council, Councillor Rodgers moved the sealing of two agreements—one between the Corporation and the Newcastle Electric Supply Co., Ltd., and the other between the Corporation and the Newcastle and District Electric Lighting Co., Ltd. He said the first had reference to the supply of electricity in Walker. The Council were under an obligation in Walker to take their electric supply from the Electric Supply Co., although they thought that when the Electric Supply Co.'s (1903) Act was before Parliament the Corporation had got powers which exempted them after August, 1910. An injunction was obtained, however, against the

Corporation in 1910 by the Supply Co., and, the reading of the clause being faulty, left the Corporation in the position of having to take their electricity from the company. To correct this error was the principal reason why the Corporation's Parliamentary Bill was promoted, so that they might set aside the clause which compelled them to take their electricity from that source. For eight years they had been paying £1,350 per year compensation under the old agreement, but since January this year they had been taking electricity from the company. This had cost them at the rate of £2,400 per year. During the progress of the Corporation's Bill they entered into negotiations with the Supply Co., and the result was embodied in the present agreement, which was that they should pay the Supply Co., £12,250 for compensation or expenses, and the Corporation were to have the right to supply their own current in Walker. By this means they would save about £2,000 per annum. The second agreement was for the supply of current to the trams at Newburn. Originally it had been decided to take current for this section from the Newcastle Electric Supply Co. at a cost of ·55d. per unit, but this would have necessitated the Corporation spending £10,500 on a sub-station. As a result of negotiations between the Corporation and the Newcastle and District Co., the latter had made an arrangement with the Supply Co., under which the District Co. would supply the Corporation tramways in Newburn at a cost of 1·1d. per unit, and the Corporation would cease altogether to take current from the Newcastle Electric Supply Co. The sub-station under this arrangement would not be needed. The agreements were ordered to be sealed.

Oldham.—At the T.C. meeting on the 3rd inst., discussion took place as to the desirability of running railless trams on the new route which is to be opened from Moorside to Grains Bar. Councillor Isherwood, chairman of the Tramways Committee, stated that the railless system would cost about £1,400 or £1,500 per mile, instead of £10,000 or £12,000 per mile, which was the cost of the present system.

On Saturday evening in Manchester Street, Oldham, an Oldham electric car going in the direction of Manchester, suddenly burst into flames. There were a number of passengers inside the car, and as the flames shot up they made a rush for the door. All got out safely, and the inside of the car was quickly enveloped in flames, which were extinguished by sand, but not before much damage was done. The seats were badly burnt, and the windows broken. The car had to be removed to the depôt.

Richmond.—No arrangement has yet been come to with regard to the electrification of the Kew Road Tramway. At the last meeting of the T.C. a proposal that permission be given to the company to put up specimen standards was defeated.

U.S.A.—According to the *Electrical World*, much favourable comment has been created by the successful operation of an automatic emergency brake on a New York subway train when Motorman Stone died while the train was running at full speed on July 15th. It is believed that the motorman was killed by striking a post while leaning from the side of the cab. The push-button relay switch on the controller handle acted immediately to set the brakes and bring the train to rest within several hundred feet.

Wallasey.—The annual statement of accounts with reference to the municipal undertaking, includes an encouraging report *re* the working of the tramways for the first three months, which discloses a surplus equal to half of the estimated surplus for the whole year. The Poulton and Wallasey Village route showed the most encouraging results.

West Africa.—It is proposed to improve the Congo line from Matadi to Leopoldville by electrification, and also to lay a pipe line between the two termini for supplying the steamers on the upper river with crude petroleum to take the place of wood fuel.—*British South African Export Gazette.*

TELEGRAPH and TELEPHONE NOTES.

Anglo-Belgian Telephony.—A double-loaded cable is to be laid between La Panne, in Belgium, and St. Margaret's Bay.

France.—Although the hour at mid-day is daily signalled throughout France from the Eiffel Tower by wireless telegraphy, a recent decree of the Administration of Posts and Telegraphs forbids French clock-makers to set up receivers to regulate their clocks and watches. The reason for this is that the Administration claims the monopoly of working the system of wireless telegraphy. *L'Industrie Electrique* waxes scornful over this latest exhibition of obstruction to private enterprise, and points out that the watchmakers of Chaux de Fonds, in Switzerland, are allowed to make use of the Eiffel Tower signals, while their use is denied to the French watchmaking industry. A curious feature is that, according to our contemporary, among the eminent persons forming the staff of the Posts and Telegraph Administration, there is no one competent to make use of the system. *L'Industrie Electrique* adds caustically: "Its telegraph service leaves much to be desired; its telephone service is—what we know; and its wireless service—nil."

International Telephony.—A Bill sanctioning the provision of telephonic communication between Milan, Zürich, Basle, Frankfort and Berlin, has been passed by the Italian Parliament. The installation of the line will be a very important undertaking.

New Cable.—The Northern Telegraph Co. has laid a new direct cable between Nystad, in Russia, and Grisslehaum, in Sweden. This is the third cable between these points, and is 198¼ km. in length.

New Pacific Cable.—The Bill referred to under this heading recently provides for the extension of the Pacific Cable from Australia to New Zealand, as asked for by the representatives of those Dominions at the Imperial Conference.

Wireless Telegraphy.—Under an agreement entered into by Marconi's Wireless Telegraph Co., Ltd., the Marconi Wireless Telegraph Co. of Canada, Ltd., and the Marconi International Marine Communication Co., Ltd., on the one hand, and the Canadian Government on the other, says the *Marconigraph*, the Marconi companies undertake to transmit general messages between stations on the Atlantic coast of Canada and corresponding stations on the coast of Great Britain and Ireland, at not more than 10 cents per word for such messages, which is 60 per cent. less than the rates now charged for cablegrams across the Atlantic the rate for the latter being 25 cents per word. Press messages will be transmitted at a shore-to-shore rate not exceeding 5 cents per word, and messages in connection with weather conditions and forecasts, tide conditions, ice, and reports on aids to navigation, will also be transmitted at that rate. The Montreal and Three Rivers stations pass into the possession of the Government for a substantial consideration, and the Marconi companies undertake to maintain and operate the Government-owned wireless stations in Newfoundland, Quebec, Nova Scotia and New Brunswick. This contract remains in force for 20 years.

The Postmaster-General has agreed that Press messages sent through the station in Sydney shall be charged at the rate of 25 words for 2s. 6d.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—Tenders for four double-deck cars. Drawings and specifications from R. Stuart Pilcher, general manager.

Australia.—Victoria.—September 5th. (*a*) 10,000 protectors and (*b*) sundries, for the P.M.G.'s Department. See "Official Notices" July 28th.

South Australia.—August 23rd. Telegraph and telephone material for the P.M.G.'s Department. See "Official Notices" July 7th.

August 30th. P.M.G. Insulators, copper wire and sleeves. See "Official Notices" July 14th.

New South Wales.—Telephone, telegraph and electric light material for a year, and a dessiccating plant for the P.M.G.'s Department. See "Official Notices" July 28th.

Queensland.—August 23rd. Letter-box fronts, for the P.M.G.'s Department. See "Official Notices" June 30th.

Belgium.—October 3rd. La Société Nationale des Chemins de Fer Vicinaux, of Brussels, (14, Rue de la Science) is inviting tenders for the electrification of the light railway between Brussels and Haecht. The contract includes the overhead equipment, the transformer sub-station, and the supply and erection of the electrical plant for the cars.

October 6th.—The city of Mons invites tenders for the supply of electricity for lighting and power. Particulars, Secrétaire, Hôtel de Ville.

Tenders will shortly be called for at the Bourse at Brussels for electric lighting apparatus for the Belgian State Railways.—*La Lumière Electrique.*

Blackburn.—August 12th. Steam coal for a year, for the Corporation electricity department. P. P. Wheelwright, engineer and manager, Jubilee Street Works.

Brazil.—August 21st. Electric goods lift and electric crane for the Naval depôt on the Island of Cobras. Local representation. Deposit £33. Inspectoria de Engenharia Naval, Ministerio da Marinha, Rio de Janeiro.—*Board of Trade Journal.*

Tenders, returnable by August 25th, are also invited for a floating steel crane, capable of lifting up to 120 tons; likewise for two auxiliary cranes, 50 and 25 tons capacity respectively. Deposit 400 francs. Particulars as above.

September 25th.—All electric lighting fittings, fans, lamps, insulated conductors, &c., required in connection with the equipment of the new Postal Telegraph building in Port Alegre with electric light. Value about £3,100. Local representation. Deposit about £33. Directoria General do Expediente, Ministerio da Viacão e Obras Publicas, Rio de Janeiro.—*Board of Trade Journal.*

Cleethorpes-w-Thurnscoe.—September 2nd. Vulcanised bitumen distribution and feeder cables, for the U.D.C. See "Official Notices" to-day.

Croydon.—The Board of Guardians has instructed the borough surveyor to prepare a specification, with the assistance of the borough electrical engineer, upon which tenders could be invited, for electrifying the lifts at the Waingates Children's Homes. The borough electrical engineer puts the cost at £250 per lift.

Erdington (near Birmingham).—Construction of 1¼ miles of double-track tramway. H. H. Humphries, engineer to the Council, Council House, Erdington.

Farnham.—August 16th. Two high-speed Diesel oil engines coupled to two 90-KW. alternators, with direct-coupled exciters, piping, tanks, overhead traveller, &c., and main H.T. switchboard, for the Farnham Gas & Electricity Co. See "Official Notices" July 21st.

Hungary.—September 30th. The T.C. of Bestzerce invites tenders for the erection of a hydro-electric station to supply light and power. Particulars from the Burgermeisteramt der Stadt Bestzerce, Ungarn.

Ipswich.—August 24th. Paper-insulated cables for a year for the Corporation. See "Official Notices" to-day.

Penang.—September 5th. One 500-KW. steam dynamo (engine or turbine), with ejector, condensing plant and switchgear, for the Municipality of George Town, Penang. See "Official Notices" to-day.

Russia.—The municipal authorities of Kamenz-Podolsk have just invited tenders for the concession for the electric lighting of the town.

Salisbury.—Electric lighting of the Salisbury and District Joint Isolation Hospital. See "Official Notices" July 28th.

South Africa.—According to the *British & South African Export Gazette*, purchases will shortly be made by the Administration of Southern Rhodesia of copper telegraph wire for installation along the railway from Salisbury to Bulawayo, and thence to the border of the Cape Province at Ramathlabama, the cost being estimated at £20,000; also considerable quantities of material will be required for the installation of a double-wire telephone system at Bulawayo in place of the existing single lines, a scheme for which is under consideration.

Swinton and Pendlebury (near Manchester).—August 22nd. Electric lighting of new Cromwell Road School, Pendlebury. Particulars from J. T. Bushell, John Dalton Street, Manchester.

Switzerland.—A concession has been granted to Messrs. Masson, Gilliéron & Chenaux for the construction of an electric railway from Glion to Sonchaux, with a branch to Caux, the line having a length of about 5 km., and the estimated cost being 600,000 francs.—*La Lumière Electrique.*

West Ham.—August 31st. Water-tube boilers, coal-handling and discharging plant, 5,000-KW. turbo-alternator, with condensing plant, river service pipework, centrifugal pumps, and one 750-KW. converter, for the Corporation. See "Official Notices" August 4th.

Wigan.—August 14th. Best firing slack and (or) washed peas, for the Corporation electricity works for a year (12,000 tons). Harold Jevons, town clerk.

Wolverhampton.—Buildings and plant for a 1,000-KW., 440-volt direct-current generating station, for the Knowles Oxygen Co., Ltd. See "Official Notices" July 14th.

The Corporation Electricity Committee invites tenders for a 400-KW. rotary converter and switchgear, at an estimated cost of £1,600, for the purposes of the supply of energy to the Knowles Oxygen Co., Ltd.

CLOSED.

Blackburn.—The T.C. has accepted the tender of Messrs. McPhail & Simpson, Ltd., for the supply of a superheater and fittings to the electricity works.

The Council has concluded a contract with Messrs. Joseph Wright and Co. for water softening plant for the electricity works.

Bolton.—The Corporation has placed a contract for continuous current electricity meters with the Electrical Apparatus Co., Ltd.

Canterbury.—The T.C. has accepted the tender of Messrs. Wm. Cory & Sons, for coal for the electricity works for a year at the following prices:—Nixon's Navigation large steam, 13s. per ton; Rochester house screenings, 14s. 10d. per ton.

Coventry.—The B. of G. has accepted the tender of Mr. H. J. Tett, for the E.L. installation at the Nurses' Home, at £61.

Dundalk.—The U.D.C. has accepted tenders for the electric lighting scheme of the town amounting, in all, to £16,186, as follows:—

Oil engines and generators.—Messrs. Mirrlees, Bickerton & Day, Ltd.
Mains.—Messrs. Siemens Bros. & Co., Ltd.
Switchboard, &c.—Messrs. Brook, Hirst & Co.
Battery (Tudor Accumulator Co.'s plates).—Sandycroft Foundry Co.
Booster.—British Westinghouse Co., Ltd.

Erith.—The U.D.C. has accepted the tender of Messrs. Beadle Bros. for 7,000 tons of Kingsley small coal for the electricity works, at 10s. 2d. per ton, or alternatively Longhurst small coal, at 10s. 6d. per ton.

France.—The French Post and Telegraph Authorities have just placed contracts with Messrs. Geoffroy et Delore of Clichy, and the Société Industrielle des Téléphones, of Paris, for the supply, by each, of 125 km. of telephone cable.

Gillingham (Kent).—The T.C. has accepted the tender of Messrs. Wm. Cory & Son, Ltd., for Hillhouse washed nuts for the electricity works, at 13s. 7d. per ton.

Hastings.—The T.C. on Friday accepted the following tenders:—

Oliver Arc Lamp, Ltd.—200,000 pairs of carbons for Oriflamme arc lamps, 30s. per 1,000.
Main Colliery Co., Ltd.—Welsh steam coal 18s. 11½d. per ton.
A. H. Wood, Hastings.—Installing the electric light at Clive Vale Schools, £62.
Bruce & Co., Hastings.—Installing the electric light at Tower Road and Technical Schools, £100.

Liverpool.—The Mersey Docks and Harbour Board have accepted the following tenders for electric cables: Edison and Swan Co., Ltd., and India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

Manchester.—The City Corporation has accepted the tender of the Union Cable Co., Ltd., at £1,185, for service cables required during the year ending June 30th next.

Shanghai.—A large order has just been placed by the Municipal Commissioners of Shanghai for Osram lamps, which includes the following: 1,000 of the 100-C.P. size, 500 of the 200-C.P. size, and 200 of the 400-C.P. size.

Shrewsbury.—The T.C. has accepted the tender of Messrs. Danks & Co., Ltd., of Oldbury, for a boiler for the electricity works, at £422 10s., and that of Mr. Henry Price, of Shrewsbury, for boiler house extensions.

Stockport.—The T.C. has accepted the following tenders:—

Messrs. Walter Scott, Ltd., Leeds.—Tram rails, £6 15s. per ton, and fish plates, £9 15s. per ton.
Walker's Road and Destination Indicators, Ltd., Bradford.—36 destination indicators, £18.
Bell Punch and Printing Co., Ltd.—Tramway tickets, 1¾d. per 1,000.
Morgan Crucible Co., Ltd., London.—Carbon brushes.
British Insulated & Helsby Cables, Ltd.—Overhead line material.

Tunbridge Wells.—The T.C. has accepted the tender of the Western Electric Co. for cables for a year, and that of Messrs. Harris, Hardman & Co., Ltd., for Yorkshire nuts for the electricity works, at 15s. 6d. per ton.

Watford.—The Council has accepted the tender of Ferranti, Ltd., at £175, for switchgear.

NOTES.

Electrolytic Disinfecting Fluid.—The annual report of Dr. F. W. Alexander, Medical Officer of Health to the Poplar Borough Council, on the manufacture and use of the electrolytic disinfecting fluid made under his supervision shows, as usual, very satisfactory results. The electrolytic fluid was in great demand by the public. The cost of material in manufacturing 50,726 gallons of the electrolytic fluid was as follows.—

	tons.	cwt.	lb.				
Electricity, 8,084 units at 1½d. per unit ...					£50	10	6
Chloride of magnesium	5	3	38	...	21	6	4
Salt, 9 tons					15	8	0
Caustic soda					9	7	6
Water					1	10	0
Total cost of materials to produce 50,726 gals.					£98	2	4
Electric motor for stirring : 98 units ...					0	12	3
BOTTLES AND CORKS.							
Bottles					£30	15	1
Corks					6	17	6
					£37	12	7

Since the plant has been installed, a period now reaching five years, 140,000 gallons have been manufactured, at a cost for electricity and materials of under £271. The two plants can deliver in eight hours 400 gallons of electrolytic fluid at a strength of 4·5 to 6·1 grammes of chlorine per litre. The first plant was erected at the end of 1905 at a total cost of £583 ; the second was installed at the beginning of the year 1910, and with alterations to the first plant cost in round figures £501. After working for nearly five years and not having been cleaned for a period of over 12 months, the apparatus was taken to pieces, over-hauled and thoroughly cleaned. The platinum wire and slates upon which it is wound were found in perfect condition—these are the positive electrodes, and are the costly portion of the plant. The tanks are made of earthenware (which if well glazed will never wear out). Tanks made of slate contain iron, and were being constantly destroyed by the action of the electric current and had to be often replaced.

Rubber Trees.—In discussing the question of the most suitable variety of rubber for the contemplated development of Costa Rican plantations, Senor J. E. van der Laat, editor of the *Boletin de Fomento* (organ of the Costa Rican Ministry of Commerce) has grouped in concise tabular form the principal concrete facts available with regard to Hevea, Castilloa and Ceara. These three classes of rubber tree are, he considers, the only varieties deserving consideration. As he remarks, each of them has a natural zone, where conditions are specially favourable and where the attempt to introduce any of the other classes would be a short-sighted policy.—*The India-Rubber World.*

COMPARATIVE RESULTS.

	Hevea.	Castilloa.	Ceara.
Under the most favourable conditions the first tapping can take place at the age of	3½ years	7 years	In 4th year
Product in latex is, at—			
4 years	7-11 oz.	None	Trifling
6 years	11-28 oz.	None	18 oz.
9 years	35 oz.	14 oz.	28 oz.
12 years	53 oz.	21 oz.	35 oz.
Complete development	106-140 oz.	70 oz.	53-90 oz.
Product of one acre (in full development) in dry rubber	610 lb.	305 lb.	395 lb.
Market value by latest advices	$1.44 lb.	$1.17-1-26 lb.	81-99 cents lb.
Analysis of the rubber—			
Pure rubber	94·60 %	89·19 %	76·25 %
Resin	2·66 %	12·42 %	10·04 %
Protein	1·75 %	0·87 %	8·05 %
Water	0·15 %	0·32 %	3·20 %
Ash	0·14 %	0·20 %	2·46 %
Proportion of pure rubber in latex	40-60 %	25-40 %	15-30 %
The tree thrives and can be successfully cultivated in the tropics up to the height of about	3,300 ft.	1,300 ft.	5,000 ft.
Ideal zone—			
Altitude up to	1,300 ft.	500 ft.	2,000 ft.
Average temperature	74-81° F.	77-85° F.	63-86° F.
Annual rainfall	60-80 in.	80-120 in.	30-80 in.
Exigencies of soil	Great fertility not required, but depth.	Fertility and depth required.	No great exigencies.

The Artificial Lighting of Hospitals.—In the course of a paper on "The Artificial Lighting of Hospitals," read before the Engineering Section of the Royal Sanitary Institute Congress held at Belfast on July 27th, Mr. J. Darch said that in visiting the principal London and other hospitals, he had been keenly struck with the universal want of discrimination in lighting. There was a kind of trade orthodoxy which cherished certain forms and fittings, and decided their use often in defiance of common sense. They had to avoid, on the one hand, the evils of glare, and, on the other hand, the risk of eye strain consequent upon insufficient light. In the hospital ward direct lighting lamps might be used if provided with proper shades, but everything depended on the word "proper." Glass shades and all transparencies were inadmissible, nor should any partial translucency exceed the limits of 0·1 C.P. per sq. in. If bracket lights were used for general lighting, a half-circle shade should be used so as to illuminate the wall. The practical result was a soft all-over illumination which was very pleasing. Indirect lighting by means of the inverted electric arc was deservedly gaining favour, but he did not recommend it for the ward, as the ceiling would be too dazzling for those who had to lie on their backs. A happy effect might, however, be obtained from indirect lighting with tungsten or other metalic-filament lamps placed inside a shallow metal bowl, white on the inside. To obtain the best effect they should be hung as low as convenient, and the lamp should not be set too low in the bowl. In electric lighting, several expedients for night-lights had been adopted, but a 2-C.P. shaded lamp was the most economical. An excellent arrangement was indirect lighting from a 8-C.P. lamp in a small bowl which was employed for night purposes only at Tooting Bec Asylum. The operating theatre needed good artificial light, and plenty of it. Electric arc lamps were employed in some Continental theatres. Direct lighting with ordinary arc lamps was out of the question on account of the unavoidable shadows, excepting, perhaps, for general lighting, but where there was a large skylight a splendid direct illumination might be obtained from white flame arc lamps, which had a remarkably high efficiency, and threw most of their light downwards. Four of these might be suspended over, but not too close to, the ceiling light, which should be of clear fluted glass, to spread the light. Indirect arc lighting, particularly where there was no skylight, was eminently suitable. Four 10-ampere open arcs, properly placed, and reflecting directly against a white ceiling, would give a brilliant illumination with all the advantages of daylight. Mr. Leon Gaster (Society of Illuminating Engineers), stated that the French Government had recently appointed a committee, composed of physiologists, architects, engineers and others, to report on different illuminants, their hygienic aspects, and so on, and it was greatly to be hoped that the Home Office of this country would do something of the same kind. Major Morgan said they had lately installed electricity in the large military hospital at the Curragh. Major Blackman said he thought the lighting of barrack rooms was a matter the Government might well take up. Mr. E. T. Hale, F.R.I.B.A., said his own preference was for a light about 2 ft. from the wall, but suspended from the ceiling. Mr. Darch briefly replied, and said the majority of hospitals had perfectly inefficient methods of lighting.

Accidents in Electric Lifts.—Replying in the Parliamentary papers to a question, the Home Secretary said that some years ago the Factory Department instituted inquiries with a view to ascertaining how far accidents arising in connection with the use of hoists or lifts might be preventible by means of automatic or other appliances attached thereto. As a result, a full report was issued in 1904 dealing with the construction and arrangement of lifts and the means of preventing accidents. Further inquiries were now proceeding with regard to hoists which were worked electrically. Mr. Churchill added that he had no power to take any action with regard to hoists used elsewhere than in places to which the Factory or the Mines Acts apply.

An Electrical Discharge (?)—A correspondent provides what appears to be an adequate explanation for the curious effects shown in the photograph reproduced on page 100 of our issue of July 21st. In tank or "stand" development the negatives are for long periods immersed in the developer in a vertical position, and as the fluid slowly circulates, those portions of it which pass over parts little affected by light (as the dark sail and mast of the boat) are less impoverished than other portions, with the result that they develop the adjoining areas with undue vigour, and produce an excess of density. Assuming the negatives to be upside down in a bath of this type, this explanation amply suffices to account for the light streamers above the masts and sails.

Smoke Abatement Exhibitions and Conferences.—The great success which attended the Exhibition of Smoke Abatement Apparatus and Appliances, held at Glasgow in the autumn of 1910, has led to the organisation of two other Exhibitions on similar lines, the first being planned for Manchester in November of the present year, while the second, which will be international in character, is to be held in London in May, 1912. In each case a conference of public authorities, manufacturers and sanitary officers interested in the problem of smoke abatement, will be held during the Exhibition, and at these conferences papers will be read and discussed. The following details will be of interest to many of our readers.

Arrangements are now well advanced for the Smoke Abatement Exhibition, which is to be held in the City Exhibition Hall, Manchester, from November 10th to 25th next. The Exhibition is being organised by the Manchester and District Smoke Abatement Society, with the support of the Smoke Abatement League of Great Britain and the Coal Smoke Abatement Society. The general manager is Mr. Walter Cawood, and the Special Advisory Committee, which has Alderman Robert Gibson as chairman, consists of the Chairmen of the Gas, Electricity and Sanitary Committees of the Manchester and Salford Corporations, together with the technical heads of several gas and electricity undertakings, and other gentlemen interested in the Smoke-abatement movement. The scope of the Exhibition is to be very extensive, and it is expected that it will embrace a very complete range of gas and electrical appliances for lighting, heating, cooking, ventilating, &c. Everything that experience can suggest will be done to secure that the Exhibition shall attract the attention of the public. The Conference of the Smoke Abatement League of Great Britain will be held in Manchester, while the Exhibition is in progress.

The Manchester Corporation has agreed to fix or wire free of charge all electric heating appliances sold at the Exhibition. The space in the gas, electrical and mechanical sections of the Exhibition is being rapidly taken up (see *Chem. Trade Journal*, July 15th and 22nd).

The London Coal Smoke Abatement Society has undertaken the

organisation of the London Exhibition and Conference, which is to be international in character, and is designed to cover all the best recognised means for diminishing or abolishing factory and domestic smoke. The last International Exhibition of this kind was held in the Royal Albert Hall in 1881, and it is felt that after the lapse of 30 years, the time has arrived when another International Exhibition is called for. The 1912 Exhibition will be held from May 6th to 18th in the Royal Agricultural Hall, Islington.

Much support has been already accorded to the undertaking as the result of the preliminary announcement of the Exhibition. This has amply justified the expectation that an International Exhibition of this character will be heartily welcomed, and there is every indication that the undertaking will prove the largest and most representative display of smoke preventing appliances and apparatus, and of smokeless fuels ever held.

An influential Council has consented to serve, and the scope of the Exhibition is sufficiently wide to cover all appliances directly or indirectly concerned in the abolition or diminution of smoke or dust from chimneys, and in the more perfect combustion of fuel.

Particulars of the Exhibition and of the tariff for floor space can be obtained from the Organising Manager and Secretary at the Exhibition Offices, Balfour House, Finsbury Pavement, London, E.C.

Ozonisers as a Day Load.—Referring to the article by Mr. J. B. C. Kershaw in our last issue, Messrs. Ozonair, Ltd., point out that the author states at the foot of page 166 that "The ozoniser is of the plate type, no dielectric of glass or other material separates the two discharging surfaces, and sparking is avoided by employing copper gauze as the electrode material"; but they have not used copper gauze for their electrodes for over five years, it having been their practice to use an alloy of aluminium exclusively. They suggest also that the statement is somewhat contradictory, as it is first said that they use no dielectric, and then (lower down) that each complete element of the ozoniser is composed of a thin sheet of micanite with gauze on either side.

Educational Notes.—Glasgow and West of Scotland Technical College.—The new session begins on September 26th (evening classes September 21st). Very large extensions to the engineering laboratories have recently been completed. Some particulars of the courses are given in our advertisement pages to-day.

Appointments Vacant.—Instructor in telegraphy and telephony for the evening classes at the East Ham Technical College (10s. 6d. per evening); junior drawing office assistant in the mechanical engineering department (£100), and assistant junior demonstrator in the electrical engineering and applied physics department (£80), at the Northampton Polytechnic Institute; clerk for the Swindon Corporation electricity and tramways departments (£70). See our advertisement pages to-day.

Machine Man Fined.—George Ferguson, machine man, pleaded guilty in Falkirk Sheriff Court on Monday, to having, while in charge of an electric coal-cutting machine in Craigend Colliery, failed to have the earth wire of the machine connected with the gate-end box. The machine, as a result, became charged with electricity and dangerous. Accused himself received a shock, and was off work for three weeks as a result. He was fined 5s. for the offence.

Annual Outing.—On Saturday, August 5th, the employés of Ozonair, Ltd., visited Hastings on the occasion of their first staff outing. The weather was excellent, and the catering and travelling arrangements were ideal. There was unanimous appreciation of a thoroughly enjoyable day, which everyone hoped was but the precursor of an annual event.

Institution and Lecture Notes.—The Institute of Metals.—The annual autumn meeting of the Institute will be held at Newcastle-on-Tyne on September 20th, 21st and 22nd. The Hon. Sir Charles A. Parsons is acting as chairman of the Local Committee, and Dr. J. T. Dunn as honorary secretary. Applications for membership should be sent to the secretary, Mr. G. Shaw Scott, M.Sc., of Caxton House, Westminster, S.W., before August 15th, to be in time to take part in the Newcastle meeting.

Institution of Municipal Engineers.—On July 29th a meeting was held at Edinburgh, and the "Scottish District" of the Institution was formed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The marriage took place at Fulham, S.W., on August 2nd, of Mr. Ernest M. Pearson, of the staff of the York Corporation Electricity Works, and Miss Annie Josephine Taylor, eldest daughter of Mr. Taylor, of Fulham.

The salary of Mr. Calvert, the Finchley Council's electrical engineer, is to be increased from £525 to £575 per annum, as from July 1st, 1911.

The Epsom U.D.C. has decided to increase the salary of the resident electrical engineer, Mr. A. C. Gilling, from £210, by £20 as from August 15th, and by £10 a year until a maximum of £250 is reached.

Mr. H. N. Warburton, late manager and secretary to the Winchester E.L. Co., has commenced practice as a consulting engineer at 4, Upper High Street, Winchester, and 31, Great James Street, Bedford Row, London, W.C.

Mr. K. N. Saye, senior station supervisor of the Electrical Department at Portsmouth Dockyard, has been presented by the staff with a gold lever watch and travelling case on his departure for the Straits Settlements.

The Winchester T.C. has appointed Mr. R. Ayton as resident engineer of the electricity works.

Mr. C. W. Rycroft, chief assistant engineer at Swindon, has withdrawn his resignation.

Tramway Officials.—Inspector Cole, in the employ of the South Lancashire Tramways Co., has been presented with a gold watch on his departure for New Zealand.

General.—The *Board of Trade Journal* states that Mr. C. Hamilton Wickes, H.M. Trade Commissioner in Australia, who recently revisited this country under instructions, is now on his way back to Australia. Any inquiries which British firms may desire to address to him should be sent to his office at Equitable Building, Melbourne. During his stay Mr. Wickes visited 24 Chambers of Commerce, and interviewed over 400 firms.

The staff and foremen of Messrs. Crompton & Co., Ltd., Arc Works, Chelmsford, have presented a canteen of cutlery to Mr. M. E. Sizer on his marriage.

The Postmaster-General has appointed Sir Alexander King, K.C.B., to be Secretary to the Post Office, in place of Sir Matthew Nathan, G.C.M.G.

Mr. Edison arrived at Liverpool on Tuesday last, on his first holiday for 25 years; he intends to visit various places in this country, including his cinephonograph works at Willesden, and will later proceed to Germany. He is accompanied by his wife and son.

Mr. Thos. Scharffetter, of 81, Peter Street, Manchester, has resigned his position with the Lahmeyer Electrical Co., Ltd., and has been appointed outside representative of the Electrical Engineering and Agency Co., Ltd., 109-111, New Oxford Sereet, London, W.C.

Mr. Henry V. Browne, after 32 years' service as superintendent of the Direct Spanish Co.'s station at Barcelona, has taken charge of the Marseilles station of the same company. To mark the esteem of the French colony of Barcelona, the honorary distinction of "Officier de l'Instruction Publique" was conferred upon him by the French Government on his leaving Barcelona, at the unanimous request of the colony. Mr. Browne was also founder and President of the British Chamber of Commerce for Spain.

Mr. Balsillie has been appointed Director of Wireless Telegraphy for the Commonwealth of Australia, at a salary of £600 a year, and has left for that country.

Obituary.—The death occurred on August 1st of Mr. John A. Surtees, the newly-appointed manager of the Cromer station of the Urban Electricity Supply Co., a position he was just about to take up. Mr. Surtees, who died from Bright's disease at the age of 33 years, had been at Grantham for eight years, latterly as local manager for the Urban Electricity Supply Co., and formerly as accountant for the Grantham and Stamford stations.

Mr. C. W. Pearson, a member of the firm of Pearson Bros., electrical engineers, Nottingham, who was recovering from a breakdown through overwork in connection with the Coronation celebrations, leapt from an express train on Monday night, and received terrible injuries, from which he died in a few hours.

NEW COMPANIES REGISTERED.

Anglo-French Wireless Co., Ltd. (117,056).—This company was registered on July 29th, with a capital of £50,000 in £1 shares, to carry on the business of electrical and mechanical engineers and contractors, suppliers of electricity, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, &c., to acquire certain inventions, patents, rights, privileges and other property relating to wireless telegraphy and telephony, and to adopt an agreement with Compagnie Generale Radiotelegraphique. The subscribers (with one share each) are:—H. Mesnil, 11, New Court, Carey Street, W.C., French advocate; F. P. Winterbotham, 1, New Court, Carey Street, W.C., solicitor. Private company. The number of directors is not to be less than two or more than five; the first are M. Sins and M. Trouchon; no qualification necessary; remuneration as fixed by the company. Registered by Waterhouse & Co., 1, New Court, Carey Street, W.C.

Provincial Electrical Co., Ltd. (116,972).—This company was registered on July 24th, with a capital of £250 in £1 shares, to carry on the business of electricians, electrical engineers, manufacturers of and dealers in apparatus and plant for electric lighting, telephones, telegraphs, or for producing power by means of gas, electricity, hydraulic, steam and other means, &c. The subscribers (with one share each) are:—W. H. Buxton, Easy Row, Birmingham, manager; W. E. Richardson, 41, Church Street, Birmingham, solicitor; H. H. Butler, Drayton Road, Edgbaston, Birmingham, traveller; W. H. Bagley, 52, Great Hampton Street, Birmingham, manufacturer. Private company. The number of directors is not to be less than three or more than five; the first are W. H. Buxton, W. H. Bagley and F. E. Butler; qualification, 15 ordinary shares; remuneration as fixed by the company. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Compania de Electricidad de la Provincia de Buenos Aires, Ltd. (117,118).—This company was registered on August 3rd, with a capital of £1,000,000 in £1 shares, to carry on the business of electricians, electrical, water, gas and mechanical engineers, suppliers of electricity, galvanism, magnetism and gas for light, heat, traction, motive power, transmission of sound and otherwise, manufacturers of and dealers in cables, wires, lines, connections, lamps, dynamos, generators, accumulators, gasometers, pipes and mains, railway, tramway, omnibus, carriage, motor car and van proprietors, transmitters of telephonic and telegraphic communications outside the United Kingdom, &c., and to adopt an agreement with Alex. L. Secretan & Co., Ltd. The subscribers (with one share each) are:—W. Stewart Lane, 5, Galpins Road, Thornton Heath, secretary; J. Heattie, 51, Christchurch Street, Chelsea, clerk; A. J. Culley, Friars House, New Broad Street, E.C., secretary; A. E. Rowland, 54, Hamfrith Road, Romford Road, Stratford, clerk; R. C. Howley, 11, St. Anne's Road, Leytonstone, clerk; F. C. Kempfield, 564, Salisbury House, E.C., director; R. W. Worsley, 564, Salisbury House, E.C., secretary. Minimum cash subscription, seven shares. The number of directors is not to be less than two or more than 12: the subscribers are to appoint the first directors. The directors shall establish an advisory board in Buenos Aires for the supervision of the company's affairs in the Argentine Republic, and such board shall not incur liabilities exceeding £500 at any one time; qualification, £200; remuneration of directors and members of advisory board £120 each per annum (chairman, £160) and 2 per cent. of the available net profits, devisible. Registered by Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C.

Magic Appliances, Ltd. (117,110).—This company was registered on August 2nd, with a capital of £5,100 in 5,000 ordinary shares of £1 each and 2,000 deferred shares of 1s. each, to carry on the business of electrical and general engineers and contractors, manufacturers of and dealers in electrical and mechanical appliances, &c. The subscribers (with one share each) are:—W. Schmahl, Creek House, Broom Water, Teddington, electrical manufacturer; S. J. Atkinson, 11, Farringdon Avenue, E.C., electrical engineer. Private company; the number of directors is not to be less than two or more than five; the first are W. Schmahl (managing director), S. J. Atkinson, A. Stolberg and O. Rouff; qualification, 10 ordinary shares; remuneration (except managing director), one guinea each per meeting attended. Registered office, 6, Farringdon Avenue, E.C.

Ohio Power Syndicate, Ltd. (117,111).—This company was registered on August 2nd, with a capital of £2,000 in £1 shares, to carry on the business of electricians, suppliers of electricity for light and power, &c. The subscribers (with one share each) are:—M. Ross, 43, Deronda Road, Herne Hill, S.E., clerk; H. G. Rushen, Cromwell Lodge, East Finchley, N., clerk; W. Postlethwaite, 119, Mildmay Road, Mildmay Park, N., secretary; W. B. Gaurt, 12, Donovan Avenue, Muswell Hill, N., accountant. Private company. The number of directors is not be less than three or more than five; the subscribers are to appoint the first. Registered office, 123, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bridgwater and District Electric Supply and Traction Co., Ltd. (76,429).—Return dated May 4th, filed May 11th, 1911. Capital £20,000 in £1 shares (5,000 preference); 12,899 ordinary and 525 preference shares taken up; £4,552 paid on 4,017 ordinary and 525 preference, including £10 on 100 forfeited shares; £8,882 considered as paid on 8,882 ordinary shares. Mortgages and charges: £12,000.

Bournemouth and Poole Electricity Supply Co., Ltd. (55,189).—Return dated March 30th, filed May 5th, 1911; capital £500,000 in 25,000 ordinary, 7,500 4½ per cent. preference and 17,500 6 per cent. second preference shares of £10 each; 15,000 ordinary, 7,500 4½ per cent. preference and 15,000 6 per cent. second preference shares taken up; £375,000 paid. Mortgages and charges: £187,500.

Garnbica Quarry and Lighting Co., Ltd.—Particulars of £200 debentures, created June 16th, 1911, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £100. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Burford Electric Light and Power Co., Ltd.—Particulars of £1,500 debentures, created June 10th, 1911, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Gillingham Electric and Steam Laundry Co., Ltd. (100,194).—Further charge, dated July 1st, 1911, to secure £600, supplemental to mortgage dated November 25th, 1909, charged on the property comprised in the original mortgage. Holder: E. D. Goodwin, 207, Canterbury Street, Gillingham.

Lodge-Muirhead Wireless and General Telegraphy Syndicate, Ltd. (70,681).—Issue on July 14th of £2,000 debentures, part of a series of which particulars have already been filed.

British Westinghouse Electric and Manufacturing Co., Ltd. (62,919).—Return dated May 15th, filed July 13th, 1911; capital, £1,875,000 in 500,000 preference shares of £3 each, and 75,000 ordinary shares of £5 each. (Original capital: £1,500,000 in 200,000 preference shares of £5 each, and 50,000 ordinary shares of £10 each.) All shares taken up; £3 per share called up on 500,000; £1,500,000 paid; £375,000 considered as paid on 75,000 shares. Mortgages and charges: £1,474,953.

Eastern Telegraph Co., Ltd. (6,338).—Return dated May 31st, filed July 7th, 1911. Capital £6,000,000 in £4,000,000 ordinary stock and £2,000,000 pref. stock. All stock taken up; £6,000,000 paid. Mortgages and charges: £1,896,706.

Cedes Electric Traction, Ltd. (109,698).—Return dated July 11th, filed July 15th, 1911. Capital £20,000 in £1 shares; 3,000 shares taken up; £3,000 paid. Mortgages and charges: Nil.

Brompton and Kensington Electricity Supply Co., Ltd. (37,918).—Return dated March 30th, filed April 28th, 1911. Capital, £300,000 in £5 shares (9,551 preference). 9,551 preference and 30,449 ordinary shares taken up. £5 per share called up on 9,551 preference and 29,449 ordinary. £195,000 paid. £5,000 considered as paid on 1,000 ordinary shares. Mortgages and charges: Nil.

Camborne Electricity Supply Co., Ltd. (57,950).—Return dated June 14th, filed July 3rd, 1911. Capital, £10,000 in £1 shares. 607 shares taken up. £1 per share called up. £605 paid, leaving £2 in arrears. Mortgages and charges: Nil.

Calcutta Tramways Co., Ltd. (14,764).—Return dated May 3rd, filed June 17th, 1911. Capital £1,400,000 in 140,000 ordinary and 140,000 preference shares of £5 each. 137,610 ordinary and 47,295 preference shares taken up. £2 per share called up on 4,400 ordinary, £2 10s. per share on 8,000 ordinary, £3 10s. per share on 22,000 ordinary, £5 per share on 79,430 ordinary and £5 per share on 47,295 preference. 23,780 ordinary considered as fully paid; £3 per share considered as paid on 4,400 ordinary, £2½ 10s. per share on 8,000 ordinary and £1 10s. per share on 21,000 ordinary. Mortgages and charges, £350,000.

Lamplough & Son, Ltd. (99,688).—An agreement, and a debenture issued pursuant thereto, both dated June 29th, 1911, to secure £3,000, charged on Lamplough Works, 2, Albany Works, Willesden; benefit of a licence, and the company's undertaking and property, present and future, including uncalled capital. Holders: London Steel Castings Co., Ltd., 56, Moorgate Street, E.C.

Rio de Janeiro Suburban Tramways, Ltd. (110,272).—Issue on July 13th, 1911, of £25,000 debentures, part of a series of which particulars have already been filed.

Waltons & Co., Ltd. (87,797).—Issue on June 20th, 1911, of £50 debentures, part of a series of which particulars have already been filed.

CITY NOTES.

The B.E.T. Capital Reorganisation Scheme.

The somewhat complicated scheme proposed by Mr. Garcke, the Chairman of the B.E.T., for the reorganisation of the capital account of that company, in consequence of the inadequacy of the revenue account to yield a surplus which will satisfy dividend requirements, and owing to the increasing arrears of preference dividend, cannot be said to possess any distinctive merit, and its adoption is not unlikely to meet with the usual reward of the application of an ineffective remedy. To those shareholders of the B.E.T. who may not be practically conversant with the affairs of companies, the interpretation of the scheme may prove to some extent a stumbling-block, and they may be unable to analyse the subject of the memorandum to the best advantage without the disinterested aid of an independent expert.

Instead of a reduction of capital, which seems to have been of general expectation, the proposition consists merely of a re-arrangement of the existing capital, which, in the circumstances, is not generally regarded as being characteristic of financial wisdom, though it is not doubted that the scheme has been conceived in the interests of the shareholders. All such proposals are usually so constructed; but it is possible that they may be born of failure (by a few at the expense of the many) to appreciate the true requirements of the situation or to the possession of undue optimism of the resources and prospects of the undertaking, which, in this case, has been described as an unhappy one, as the loss sustained by investors has been undoubtedly great.

The present issued and fully paid share capital of the company is:—

161,437 6 per cent. cumulative preference shares of £10 each	£1,614,370
133,301 ordinary shares of £10 each	1,333,010
Total	£2,947,380

If the scheme submitted be carried out, this share capital will become as under:—

(A)	403,592½	cumulative first preference shares of £1 each entitled to 6 per cent. ...	£403,592	10 0
(B)	403,592½	non-cumulative preference shares of £1 each entitled to 6 per cent. ...	403,592	10 0
	807,185		£807,185	0 0
(C)	1,606,991	preferred ordinary shares of £1 each entitled to 6 per cent. ...	£1,606,991	0 0
(D)	533,204	deferred ordinary shares of £1 each	533,204	0 0
	2,947,380	Total	£2,947,380	0 0

This, it will be observed, is the same in total as the existing issue share capital. There will thus be four classes of shares of the new denomination of £1, as against the present two classes of shares of the denomination of £10.

As regards priority of capital, the shares (A) will rank first, (B) second, and (C) and (D) will rank *pari passu*.

As regards priority of dividend the following represents the order:—

(A) 6 per cent. on 403,592½ cumulative preference shares of £1 each will require per annum ...	£24,215 11 0
(B) 6 per cent. on 403,592½ non-cumulative preference shares of £1 each will require per annum	24,215 11 0
(C) 6 per cent. on 1,606,991 preferred ordinary shares of £1 each will require per annum ...	96,419 9 2
(Here apparently follows the payment of the present arrears of preference dividend, viz., £266,370 1s.)	
(D) The 533,204 deferred shares of £1 each may be considered as so much waste paper, and in present circumstances the probability of any adequate return on the preferred ordinaries would appear to be dim and distant.	
Total required per annum ... ... (excluding arrears and D)	£144,850 11 2

It may be remarked here that at present the debenture stocks of the company impose an annual charge for interest of £92,994.

Each existing cumulative preference shareholder will receive in exchange for his £10 share the following :—

Existing cumulative preference share of ... will be exchanged for—	...	...	£10
£2½ first preference shares of £1	...	£2 10 0	
£2½ second preference shares of £1	...	2 10 0	
£5 preferred ordinary shares of £1	...	5 0 0	
			£10

Each existing ordinary shareholder will receive in exchange for his £10 share the following :—

Existing ordinary share of		£10
Will be exchanged for—		
6 preferred ordinary shares of £1	£6	
4 deferred ordinary shares of £1...	4	£10

It will thus be seen (1) that although the preference shareholders will get 6 per cent. if earned, the cumulative preference dividend is reduced from 6 per cent. to 1½ per cent. ; (2) that the proposed cumulative preference share capital of £403,592 10s. will rank in any distribution of assets in priority of other classes of shares (at present the preference and ordinaries rank *pari passu*) ; and (3) that the present ordinary shareholders, if they surrender their *paripassu* rights, receive certain preferred ordinary shares, as shown, on which (the best that can be said at present) a dividend may be impossible for some considerable time, whilst they lose £533,204 in the shape of the deferred ordinaries.

The net result, therefore, is that the preference shareholders waive in favour of the ordinary holders part of their dividend rights for part priority of capital rights, and that the ordinary holders waive a portion of their capital rights to the preference holders for a return remote, though anticipated, on the preferred ordinary shares, whilst the £533,204 referred to, may be treated apparently as a negligible quantity.

The scheme would appear to possess all the elements of an ineffective solution of the difficulty, and does not impress us, having regard (*inter alia*) to the fact that there are, according to the last published balance-sheet, £1,679,007 of securities, yielding no return ; that there is a large depreciation of B.E.T. securities ; and that the creation of deferred shares is objectionable.

With regard to the question of the influence of the local authorities in B.E.T. finance, it would seem that the position is that the B.E.T. is determined to get all that it can out of them upon the sale of undertakings, and that the local authorities are resolved upon giving the B.E.T. as little as possible—two extremes—which may or may not be due to the B.E.T.

North Metropolitan Tramways Co.

THE directors' report for the half-year ended June 30th, states that the gross revenue amounted to £368 and the total expenditure to £296, leaving as net profit £72. This balance of £72, together with £759 from last account, make up a sum of £831, which is carried forward to next account. The London County Council gave up possession of the Leytonstone Car Works on March 31st last, and the various tools and machines have been catalogued with a view to their disposal. What is not sold by private treaty will be put up for public auction next October, when the car works and freehold land are to be offered for sale.

The eighty-third half-yearly general meeting of the shareholders of the above company was held on Wednesday, at Electrical Federation Offices, Kingsway, Mr. George Richardson presiding.

The CHAIRMAN, in moving the adoption of the report, said the gross revenue for the half-year had amounted to £368 13s., and the total expenditure to £296 5s. That left a net profit of £72 8s., which, together with £759 2s. 7d. from the last account, they proposed to carry forward. Since the issue of the report they had entered into negotiations for the sale of their Roman Road depôt, and if they could dispose of the Barking Road depôt they would be able to go into liquidation in October.

MR. J. W. GREIG seconded the motion, and the report was adopted.

Tyneside Tramways and Tramroads Co.

THE directors' report for the half-year ending June 30th, 1911, states that the surplus of receipts over expenses is £4,288, which, with the balance brought forward of £456, makes a total to the credit of profit and loss account of £4,744, and after deducting interest on debentures, loans, &c., amounting to £989, there remains an available balance of £3,755. This profit the directors propose to appropriate in the payment of dividend on the preference shares at the rate of 5 per cent. per annum (less income-tax), £601 ; in the payment of dividend on the ordinary shares at the rate 1½ per cent. per annum (less income-tax), £1,004 ; in placing to the credit of reserve for renewals, depreciation and other contingencies, thus increasing the amount to £10,100, the sum of £1,000 ; and in setting aside for the reduction of registration and formation expenses, &c., £530 ; leaving to be carried forward to next half-year £619. The traffic receipts show an increase of £832 as compared with the corresponding period of last year, due largely to the improved trade of the district.

The half-yearly meeting of the company was held in Newcastle-on-Tyne on the 8th inst., Dr. J. T. Merz presiding.

The CHAIRMAN, in moving the adoption of the report, said the receipts per car-mile had increased to 8·87d., against 8·273d. for the corresponding period of last year. These were the largest receipts per car-mile they had recorded, the nearest being 8·8d in 1907. They had carried 276,600 more passengers than in the corresponding period of last year. They had increased the dividend from 1 per cent. to 1½ per cent., and had increased the reserve fund by £1,000. Referring to the Newcastle Corporation's Bill, he said the cost of the litigation to the company was £405, and although their differences could easily have been settled by a meeting in Newcastle, they had been forced to go before the Parliamentary Committee in London.

The report was adopted and dividends approved.

Great Northern and City Railway Co.

THE report for the half-year ending June 30th last, shows a total revenue of £41,844, and working expenses amounting to £20,157, or at the rate of 48·17 per cent. The net revenue amounting to £21,687 was insufficient to meet the company's fixed charges for the six months by £1,110, which, as in previous years, was provided from outside sources. The number of passengers carried during the half-year was 6,323,045, as compared with 5,966,114 in the corresponding period last year.

The half-yearly meeting of the company was held on August 2nd, at the Westminster Palace Hotel, Lord Lauderdale presiding.

The CHAIRMAN, in moving the adoption of the report, briefly dealt with the figures in it, pointing out that the company's business was slowly improving, a satisfactory feature being the comparatively small sum required from outside sources to meet the deficiency on fixed charges (a year ago the amount was £3,163). He believed the day was not far distant when they would be quite independent.

MR. CHAS. STEEL seconded the motion, which was adopted.

Chatham and District Light Railways Co.—The twenty-first ordinary meeting of the shareholders of this company was held on Thursday last week at the offices, 83, Cannon Street, E.C., Mr. A. R. Monks presiding. On the motion of the Chairman, seconded by Mr. W. B. H. Martindale, the report and accounts were adopted.

Lanarkshire Tramways Co. — The twentieth ordinary general meeting of the shareholders of this company was held on Thursday last week at the London offices, 83, Cannon Street, under the presidency of Mr. A. R. Monks. The Chairman formally proposed the adoption of the report, which was seconded by Mr. W. H. Whaite and agreed to.

Mather & Platt, Ltd.—The directors have declared an interim dividend on the ordinary shares of 5 per cent., free of income-tax, for the half-year ended June 30th, 1911, being at the rate of 10 per cent. per annum.

Oldham, Ashton and Hyde Electric Tramways, Ltd.—The directors have declared an interim dividend at the rate of 5 per cent. per annum (5s. per share), less income-tax, on the ordinary shares for the half-year to June 30th.

Edgware and Hampstead Railway Co.—The statutory meeting of the shareholders of the above company was held on Wednesday at Electric Railway House, Broadway, Westminster.

Blackpool and Fleetwood Electric Tramways.—The half-yearly meeting of this company will be held at Fleetwood on August 24th. The report shows that the number of passengers carried was 1,041,121, and the receipts were £11,801, compared with £11,341. Maintenance of ways and works cost £837, compared with £1,006 ; engine power, £1,767, compared with £1,913 ; and traffic expenses, £2,452, as against £2,411. The car-mileage run was 227,118½ miles compared with 221,356½ miles.

Continental.—La Société Nationale d'Eléctricité is the name of a new company which has recently been formed in Paris with a capital of £40,000.

La Société des Tramways et Eléctricité, of Brussels, is increasing its capital to £120,000.

London Electric Railway Co.

The directors in their report for the half-year ending June 30th point out that the comparative figures for the corresponding half of last year are those of the Great Northern, Piccadilly and Brompton, Baker Street and Waterloo, and the Charing Cross, Euston and Hampstead Railways, consolidated. The capital expenditure during the half-year amounted to £47,222. The gross receipts on revenue account amounted to £392,817, being an increase of £27,193 on the receipts for the corresponding half of last year. The working expenses amounted to £174,919, being an increase of £7,699. After providing for interest and rents, and reserving £7,500 for contingencies and renewals, there remains a balance of £124,156 available for dividends, and the directors recommend that a dividend at the rate of 4 per cent. per annum be declared on the 4 per cent. preference stock, and that a dividend at the rate of 1 per cent per annum be declared on the ordinary shares, leaving a balance of £14,516 to be carried forward to the next half-year. The directors recommend that these dividends shall be payable on August 15th. The number of passengers carried in the last two years is as follows :—

Half-year ending—	Number, inc. est. journeys by season-ticket holders.	Receipts £
Dec. 31st, 1909, Bakerloo, Piccadilly and Hampstead Railways	46,783,143	328,566
June 30th, 1910, Bakerloo, Piccadilly and Hampstead Railway	50,045,140	343,604
Dec. 31st, 1910, London Electric Railway	*46,665,279	332,563
June 30th, 1911, London Electric Railway	†52,548,384	369,326

*Prior to July 1st, 1910, a through passenger was counted as one passenger on each of the company's lines used, whereas since that date a through passenger is counted as one passenger only.

The London Electric Railway Act, 1911, the Bill for which was approved by the proprietors at a special meeting held on February 9th last, received royal assent on June 2nd last. The company proposes to proceed with the construction of the Charing Cross and Paddington extensions at an early date. The Metropolitan District Railway Act, 1911, the Bill for which was approved by the proprietors at a special meeting held on February 9th last, received the royal assent on June 2nd last. The powers conferred by this Act, whereby the Lot's Road power house undertaking is to be purchased by a Joint Committee of the London Electric and Metropolitan District Railway Companies and leased to the two railway companies, were fully explained in the circular issued to the shareholders on June 10th last. It is proposed that the power house be transferred to the Joint Committee and leased to the two railway companies as from January 1st, 1912.

South American Light and Power Co., Ltd.

An abstract of the directors' report for the year ending March 31st 1911, appeared on page 145. The following table showing the progress of the company's business is of interest :—

	1907.	1908.	1909.	1910.	1911.
Arc lamps connected ..	126	336	469	511	587
8-c.p. inc. lamps connected	13,096	21,022	29,728	39,084	44,544
Fans connected	47	124	206	200	219
Motors	3	14	38	52	75
Customers	316	462	715	900	1,106

The eighth annual general meeting of the shareholders of the company was held on Wednesday, last week, at the offices, 6, Laurence Pountney Hill, Cannon Street, the Right Hon. F. H. Jackson presiding.

The Chairman, in proposing the adoption of the report, said it was satisfactory to be able to report a further improvement in the receipts of the company as compared with the previous year; the result being that they were able to carry a balance of £9,478 to the balance-sheet, against £8,453. Turning to the balance-sheet, on the debit side it would be seen that the whole of the share capital—£150,000—had now been issued; the remaining unissued shares—£21,500—having in accordance with the decision come to last year, been allocated to the Bahia-Blanca and North-Western Railway Co. in repayment of the moneys expended by them on their behalf on capital account. They had also issued the remaining £6,500 5 per cent. mortgage debentures, and the cash proceeds were applied towards meeting the remainder of the company's obligations to the Bahia-Blanca Railway. The debentures were sold at a premium of £194, which sum had been transferred to the reserve account. On the other side of the balance-sheet it would be seen that the capital expenditure during the past year had been very heavy—£79,863, which had been expended in building three transformer sub-stations and an elaborate network of underground cables, which it had been necessary to install for present and future requirements. On the other hand, there was a reduction of £3,023 from that item in respect of meters and the whole amount in respect of meters—£4,962—disappeared from the balance-sheet. They had made an arrangement with the Bahia-Blanca Railway Co. by which the item for meters and motors should be placed to a separate account, to which would be put the rentals which the company received for those things, and after the whole of the item was wiped out by renewals, then the balance would accrue to the company. That was a slight modification of the original agreement, but they thought it mutually advantageous to make the arrangement. He wished to say a few words upon the question of the contract which they had with the municipality. As most of the shareholders were aware, that contract was entered into in 1900, and it expired at the end of last year. The Bahia-Blanca Railway had been in negotiation with the municipality on behalf of the company for a renewal of the contract for a further period of 10 years, which he understood was the limit of time for which such a contract could be given by Argentine law. A provisional agreement had been entered into, and it was probable that the final contract would conform in all material matters with that provisional agreement. They had been obliged to make certain minor concessions, but the most serious alteration in the contract was that while in the previous one it was provided that no other company could lay lines in the City of Bahia-Blanca in any street within two metres of their lines, the new contract provided that in the event of any new lines being placed in competition with theirs, they were to be compensated for any damage done to their lines. It was found by practical experience that the previous clause was a sufficient deterrent to any competition, while the new clause raised the possibility of a competitor coming on the scene. On the other hand, they must bear in mind that they were so firmly installed that it was extremely unlikely that any competitor would be able to make much headway, and, therefore, competition was not very probable. At the same time, it could not be denied that the result of the alteration of the contract must be that the security for the debentures was weakened, as competition was now more possible than it was, even if it was still improbable. The other matter he wished to refer to was that they owed the Bahia-Blanca Co. the large sum of £71,377, which, of course, they would have to meet in due course. The whole of the authorised capital of the company had now been issued, and they had an issue of £50,000 of debentures outstanding which, under the existing trust deed, could not be increased, but it was always possible for them to pay back those debentures and issue a new series of debentures for £150,000. That was practically what they proposed to do, and, in conjunction with the Bahia-Blanca Railway Co., they had formulated a scheme for that purpose, but after consultation with the railway company they had decided to defer taking any action in the matter until later on in the year. He believed the debentures would form a very attractive investment. With regard to the earnings of the company during the past year, as he had told them, their profits had somewhat increased, and, taking into consideration the suffering which had been inflicted upon the town owing to the failure of the crops, he thought they had done very well. If, as they hoped and expected, the country this year had a plentiful harvest, the prosperity of the town should materially improve, and that was sure to bring an increased demand for light and power.

Mr. T. Penn Gaskell seconded the motion.

The Chairman, in reply to questions, said it could hardly be expected that their capital expenditure would be closed for some time to come, if, as they hoped, the country continued to make progress. The mains system was laid out, and any further extensions would only be in connecting branches, which, of course, was not so costly as laying main cables.

The report was adopted.

Liverpool Overhead Railway Co.

The report of the directors to June 30th, 1911, states that the gross revenue amounted to £38,154, and the working expenses to £27,229. The number of passengers carried during the last two years is as follows :—

	Half-year ending			
	Dec. 31, 1909.	June 30, 1910.	Dec. 31, 1910.	June 30, 1911.
First-class	553,409	546,742	567,911	579,328
Third-class (including tramways)	3,184,636	3,013,785	3,260,261	3,113,073
Workmen (special return tickets)	1,477,506	1,529,553	1,563,128	1,701,196
Total	5,215,551	5,090,080	5,391,300	5,393,597

Compared with the corresponding period of last year there has been an increase in the number of passengers carried during the half-year of 303,517, producing an increase in the receipts of £1,968. The rolling stock and permanent way have been fully maintained. The company's Bill for the consolidation of its borrowing powers and for authorising the Mersey Docks and Harbour Board to guarantee the payment of interest on debenture stock, which was approved by the proprietors on February 14th last, has passed both Houses of Parliament, and now only awaits the royal assent.

The balance after meeting working expenses was £10,924, from which is deducted interest on mortgage debentures, and on calls paid in advance £4,329, leaving £6,595. With the balance brought forward, £4,246, the sum available is £10,841, and the directors recommend the declaration of dividends at the rate of 5 per cent. per annum on the preference shares, and 1 per cent. per annum on the ordinary shares, payable on and after August 17th next, leaving a balance of £4,665 to be carried forward to next half-year.

Westminster Electric Supply Corporation, Ltd.—The directors have declared an interim dividend for the half-year to June 30th at the rate of 10 per cent. per annum, less income-tax.

Metropolitan District Railway Co.

The report of the directors for the half-year ended June 30th, 1911, states that the expenditure on capital account during the half-year has been £88,669, including £10,686 in part payment of arrears of dividend on guaranteed stock. The gross receipts on revenue account have amounted to £327,170, being an increase of £27,124 on the receipts for the corresponding half of last year; the working expenses have amounted to £152,741, being an increase of £9,410. After providing for interest and other charges, and setting aside £10,000 as a reserve for renewals, the net revenue account shows a credit balance of £82,992, and the directors recommend that a dividend at the rate of £4 per cent. per annum be declared on the 4 per cent. guaranteed stock, and that a dividend at the rate of £4 10s. per cent. per annum be declared on the 4½ per cent. first preference stock. The directors recommend that these dividends shall be payable on August 15th. The following table gives a summary of comparative figures for the first halves of the years 1911 and 1910:—

	Half-year ended June 30, 1911.	Half-year ended June 30, 1910.	Increase per cent.
Gross revenue	£327,170	£300,046	9·04
Working expenditure	£152,741	£148,331	6·57
No. of passengers, including workmen and season ticket-holders' journeys	40,539,464	36,180,308	12·05
No. of passengers carried at workmen's fares	7,050,800	6,646,532	6·08
Passenger receipts	£306,428	£280,483	9·25
Average receipt per passenger	1·81d.	1·86d.	2·69
Train-mileage on District Railway	1,743,068	1,666,350	4·60
Car-mileage on District Railway	7,107,134	6,646,998	6·92

The company's passenger traffic continues to show satisfactory increases, and has justified the improved train service. The widening works between Studland Road and Acton Lane Junction will be completed by next autumn, and will afford additional facilities for further improvements in the train service. The increase in working expenses is due to the increased train service, extra expenses incurred during the Coronation period, including an extra day's pay to nearly the whole of the staff, and for extensive improvements to the rolling stock. Thirty-one new carriages have been put in service during the half-year; 20 carriages remain to be delivered by the builders, and an order has been placed for 14 additional carriages. The Metropolitan District Railway Act, 1911, received the Royal Assent on June 2nd, 1911; the powers conferred by this Act were fully explained in the circular issued to all of the shareholders on June 10th last. It is proposed that the Lot's Road power house undertaking be transferred to a Joint Committee and leased to the Metropolitan District and London Electric Railway companies as from January 1st, 1912. Clauses for the protection of this company have been inserted in the London Electric Railway Bill.

Yorkshire Electric Power Co.

The directors' report for the last half-year states that the gross profit on the revenue account for the last three corresponding half-yearly periods ending June 30th is as follows:—1911, £6,633; 1910, £4,950; 1909, £2,598. The net profit for the same periods, after deduction of mortgage interest, is £4,137, £2,622, £1,070. There has been a general increase in the sale of energy to all classes of consumers, included in which the directors are pleased to note the increase in supply to local authorities and others holding electric lighting orders, as showing a growing appreciation of the advantage of purchasing in bulk from the power company in preference to generating at their own stations. Extensions of mains and plant have been made during the past half-year to meet new demands for the company's supply. The capital expended upon these has not yet become wholly productive. Further agreements have been made for the supply of energy to power users, which will again increase the company's revenue. The balance available at June 30th last was £13,613, made up as follows:—Net profit for the year ending June 30th, 1911, £4,137; net profit accumulated up to December 31st, 1910, £9,886; less preference dividend paid to December 31st, 1910, £410. The directors recommend a dividend (less income-tax) for the half-year ending June 30th, 1911, at the rate of 6 per cent. per annum on the amount paid up on the cumulative preference shares amounting to £1,136, and to carry forward £12,476. Applications for 6 per cent. cumulative preference shares continue to be received, and at the date of this report over £83,000 had been applied for out of the £100,000 authorised.

German Electrical Companies.

The Elektrizitäts Gesellshaft vorm. Schuckert & Co., of Nuremberg, intimates that the dividend for the year 1910-11 is estimated at 7 per cent. This announcement is intended to dispel the report that a higher rate will be distributed.

The Elektrizitäts Gesellschaft vorm. C. Buchner, of Wiesbaden, reports that the turnover in 1910 slightly increased, and the net profits amounted to £1,900, as compared with £2,100 in 1909. It is proposed to pay a dividend of 8 per cent, the same rate as in the preceding year. The course of business in the present year has hitherto been satisfactory, and the company is well supplied with orders.

The report of the Gesellschaft für Elektrotechnische Unternehmungen, of Munich, records a loss of £11,000 for 1910, as against a loss of £31,000 in the previous year, the total debit balance being thereby increased to £49,000 on a share capital of £100,000, and loans of £49,000. As to the cause of the loss in 1910, the directors' report states that this was due as regards £8,500 to provision made for the winding up of Austrian transactions owing to the bankruptcy of the debtor, whilst the remainder was due to the damage to the Illachmuhle electricity works by high water, and to a business loss. The company's three electricity works experienced a satisfactory development, and the receipts promise to further increase in the present year.

The Isaria Zählerwerke, of Munich, which entered into a community of interests with the Brown-Boveri Co. last year, states that the net profits amounted to £15,000 in 1910-11, as contrasted with £13,600 in the previous year. It is intended to pay a dividend of 10 per cent. on the share capital of £75,000, being the same rate as in 1909-10. The directors' report remarks that the turnover increased in all departments, but the augmentation was only possible by agreeing to competitive prices which again largely declined without reason during the year. The expansion in business and the adoption of new manufactures induced the company to extend the factories in Munich and Schwenningen, with the result that the creditors rose from £12,000 in 1909-10 to £92,000 in 1910-11. On the other hand, the debts owing increased from £29,000 in 1909-10 to £76,000 in 1910-11 in consequence of the larger turnover and the necessity for following the example of the large firms in granting excessively long credits. It is intended to raise the share capital to £105,000.

Central London Railway Co.

The thirty-second ordinary general meeting of the shareholders of this company was held on Thursday, last week, at the Holborn Restaurant, Mr. H. F. Parshall presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 147), said that dealing first with the capital account, in April last an issue was made of £380,000 4½ per cent. preference stock, practically the whole of which was allotted to the shareholders of the company. During the half-year £51,464 had been expended on capital account, of which £40,282 was on account of the extension to Liverpool Street, and £2,617 for the high level subway connection with the City and South London Railway at the Bank Station. The work in connection with the Liverpool Street extension was proceeding satisfactorily, and certain arrangements had been made with the contractors by which the work would be completed six months ahead of the original contract time. As they expected that the extension would very considerably help their revenue, they had thought it worth while to do everything they could to accelerate its opening, and it was anticipated that unless anything occurred to delay the present rate of progress, it would be opened for traffic next year. The high level subway at the bank which was opened last May, had proved a great convenience, something like between 3,000 and 4,000 people making use of it daily. During the last half-year the railway had carried over 20 million passengers, showing a decrease of 658,609 passengers compared with the corresponding period of 1910. This decrease was undoubtedly due to the increased motor-'bus competition along the company's line of route, which had been greatly assisted by the extremely favourable weather which had prevailed. In this connection it might be pointed out that from observations made as to the number of motor-'buses passing their Lancaster Gate Station going eastward they found a one-minute service of 'buses. Twelve months ago 162 'buses passed this point in four hours, whereas the service had now been increased to 205 'buses, carrying an estimated number of 5,200 passengers, being an increase of 43 'buses with an increase of 1,400 passengers. At certain times of the day as many as eight 'buses had passed their Oxford Circus Station in one minute going Citywards, and in both directions, in one complete hour, 240 'buses had passed the station, equal to four per minute, with a seating accommodation of 8,160. The decrease in passengers might also be accounted for, to some extent, by the fact that the attendance at the Coronation Exhibition had been much less than in former years, owing presumably to the large number of counter attractions which had been opened this season. It was satisfactory to note that under the new organisation, without in any way diminishing the efficiency, there had been a decrease in the working expenses of £3,420, which had been brought about by economies effected in all the departments. The gross receipts amounted to £150,109, and after deducting working expenses, there was a balance to net revenue account of £65,901. After providing for debenture interest and other payments, and including the amount brought forward from last half-year, they had a balance of £75,655. A dividend on the ordinary stock at the same rate as last year, viz., 3 per cent., would absorb £27,351, and the preferred would take £11,766, leaving a balance of £36,538. From this balance they proposed to carry forward to the dividend suspense account the sum of £5,883 on account of the deferred stock at the rate of 2 per cent. per annum, which would leave a net balance forward of £30,665. The Bill to secure through running to the Ealing Station of the Great Western Railway had been passed by both Houses of Parliament, and now awaited the Royal Assent. There was every reason to believe that this connection would bring a large amount of extra traffic to the line, there being large opportunities for development in the neighbourhoods of Ealing and Acton, and it was believed that plans were being made for building on the undeveloped land. During the Coronation festivities a heavy train service was worked, and on the three days,

June 21st, 22nd and 23rd they carried no less than 730,000 passengers, the trains running from 3.30 a.m. to 2.30 a.m. the next day. It was gratifying to say that the vast crowds were safely carried in a comparatively short space of time without a hitch of any kind. The staff worked admirably throughout this trying period, and the Board of Trade had intimated that his Majesty the King had decided to grant Coronation medals to two members of the staff in appreciation of the splendid way in which the crowds were handled. The directors were leaving no stone unturned to make the railway as attractive as possible. On July 1st last, season tickets were inaugurated, and there was no doubt that these had been highly appreciated by the public, with satisfactory results to the company. There had been inaugurated a parcels express service, which had also proved remunerative and was a rapidly growing business. Improvements had been and were being effected at their various stations, in order to make them more attractive to the travelling public. A system of ventilation (the "Ozonair" system) was being installed throughout the line, and would be completed in the very near future. By this system some 80,000,000 cb. ft. of ozonised air was being pumped daily into the tunnels, which would be the means of rendering the atmosphere exceptionally pure. Favourable comment had already been made as to the great improvement which had been effected in the atmosphere at the Bank Station, where the system had been in operation for some weeks.

Lord St. Aldwyn seconded the motion.

Mr. Mather inquired whether the company's engineers had considered whether the time had not come to install fresh plant at the generating station. He thought that considerable economy could be effected by putting in turbine plant instead of the present engines.

The Chairman said that they had had the question of turbines under consideration, but there would not be any justification for their scrapping their existing plant at Shepherd's Bush in order to replace it with turbines. They had Corliss engines of the very best type, and to-day they were running at less than 3 lb. of coal per kilowatt-hour, which was a very fine record for a power house. There was no station in the kingdom—certainly there was none in London—which showed such good working results as they did at Shepherd's Bush.

Mr. Mather said that at Lot's Road power station they were generating on 2¼ lb. of coal per unit.

The Chairman reminded Mr. Mather that at Lot's Road they were generating upwards of 150 million units a year, while the C.L. Co. were only generating 18 millions. He might say that they had considered the question of obtaining a supply from Lot's Road, but taking the capital into consideration, they found that they could generate cheaper for themselves.

The report was adopted.

Capital Expansion in Germany.

A further augmentation of considerable extent is proposed in the capital of the Siemens-Schuckert Works, which will be remembered as being the amalgamation of the heavy electrical engineering departments of the Siemens & Halske Co. and the Schuckert Electricity Co., which hold in almost equal halves the whole of the capital in the first mentioned company. When the A.E.G. became closely associated with the Felten & Guilleaume Co. in September, 1910, and took over the latter's dynamo works at Frankfort, it was reported that the Siemens-Schuckert Works would be compelled to equalise matters, either by increasing the share capital so as to maintain the turnover on the level of the A.E.G., or that the company would have to absorb another electrical manufacturing undertaking. The name of the Bergmann Electricity Co. was mentioned in this connection, but the latter has preferred to retain its independence, and signified its decision by the announced intention of raising a loan of £500,000, which is now being admitted to quotation on the Berlin Stock Exchange. It is stated, however, that quite apart from any considerations of rivalry with the A.E.G., the Siemens-Schuckert Co. has found it necessary to raise additional capital so as to cope with the development of business which started before the A.E.G. became associated with the Felten & Guilleaume Co. In December last the Siemens & Halske Co. and the Schuckert Co. made an advance of £1,500,000 to the Siemens-Schuckert Works, and it has now been arranged to convert this advance into a non-redeemable loan bearing interest at the rate of 6½ per cent., although other creditors are given a preferential right over the loan. In addition, a 4½ per cent. obligation loan of £1,500,000 is to be issued by a syndicate headed by the Deutsche Bank, thus increasing the loan capital of the Siemens-Schuckert Works to £2,500,000, whilst the ordinary capital remains unchanged at £4,500,000. We thus have a total capital of £7,000,000, of which £3,000,000 represents increases in the course of seven months; and the former amount compares with a total share and loan capital of £9,000,000 in the case of the A.E.G. It is now announced that as the demand continues, and the turnover has experienced a very considerable increase in recent months, it is no longer possible for the Siemens-Schuckert Works to postpone extending the works and augmenting the working capital. It is estimated that sites and buildings in recent months have involved an expenditure of from £500,000 to £600,000, of which £50,000 represents the new offices on the Nonnendamm, in Berlin, where £350,000 was expended on the dynamo works completed last year. A further large sum relates to the Gartenfeld estate near Spandau, where a new cable factory is in course of erection; new transformer works at Nuremberg are costing from £250,000 to £300,000, whilst the meter factory is to be extended on the old site in the same town. It is stated that the company hopes to find profitable employment for the fresh loan capital which is being raised at the low rate of interest of 4½ per cent., although the non-redeemable loan of £1,500,000 cannot be said to be cheap at the rate of 6½ per cent.

As far as the Siemens-Schuckert Works Co. is concerned, it is mentioned, as an example of the expansion in business, that since the issue of the last annual report the number of workers employed has increased from 49,000 to 61,000, and as a consequence the augmentation in the working capital merely takes into account the effective requirements of the undertaking. The Siemens & Halske Co., whose financial policy rests in the hands of the Siemens family, and is of a tolerably conservative character, does not propose to make a fresh issue of capital. The company's last issue of an obligation loan took place in 1900, when the share capital was also raised from £2,250,000 to £2,725,000, and the last issue of shares was from £2,725,000 to £3,150,000 in 1908, for the purpose of strengthening the parent company's holding in the subsidiary companies. In the case of the A.E.G., it is announced that a fresh issue of bonds will presumably be made in the autumn in order to increase the working capital, although the question is understood to have been previously brought forward at a board meeting in the spring of the present year. At present the company is still in possession of considerable liquid funds, which are stated to amount to £2,500,000, but one-half is required for covering liabilities, and large sums will later on be needed for the extension of the business. The loan debt now reaches £2,550,000 on a share capital of £6,500,000. The last loan was issued in 1908, and amounted to £750,000, whilst the last issue of shares took place at the end of 1910 in connection with the absorption of the Frankfort dynamo works and the acquisition of a considerable number of shares in the Felten & Guilleaume Co. Although no definite information has been published in regard to the prospective loan, it is estimated that the requirements will be represented by about £1,500,000.

The prospectus issued by the Bergmann Elektrizitäts Gesellschaft, relating to the admission of £500,000 in 4½ per cent. bonds to the Berlin Stock Exchange, states that the turnover invoiced by the company to the end of May amounted to £1,150,000 as compared with £800,000 in the equivalent period in the preceding financial year, whilst the orders on hand also exceeded those on the books at the corresponding date in 1910. A further decline in sale prices has not only not occurred this year, but a slight improvement has taken place in various branches of manufacturing. It is added that if the present course of business continues it may be expected that the company's profits for the current year will be better, although it has to be remembered that the share capital participating is greater than in 1910. The Siemens-Schuckert Works Co., in announcing a further increase in capital, also reports an extraordinary augmentation in the orders received in the course of the past few months, as contrasted with the position a year ago.

The Moore Light in Germany.

The Moore Licht Aktien-Gesellschaft, which was formed in March, 1910, with a share capital of £60,000, increased the capital to £87,000 in the following August for the purpose of acquiring further foreign patents. A loss is now reported for the first financial year of £17,000, of which £5,600 represents provision made for depreciation of patents, £2,800 is written off for preliminary expenses, and £2,400 for the organisation of the Franco-Belgian business. The deficiency has been extinguished by the surrender by the directors of 340 shares, totalling £17,000, and the shareholders are now asked to agree to make an additional payment of 25 per cent. on their shares, which would then be converted into 6 per cent. non-cumulative preference shares. A Frankfort newspaper, in referring to the matter, draws a comparison between the present position of affairs and that represented over a year ago. It is stated, for instance, that in a circular issued in April, 1910, it was mentioned that orders had been received in seven weeks for about 5,000 installations of the Moore light extending over a period of three years, and that the orders would yield a profit of £112,000, whilst negotiations were proceeding in respect of the conclusion of a large number of further contracts. It was assumed that in three years from 1910 the company would earn net profits of from £150,000 to £200,000, and would be able to pay high dividends and to write off the patent account. But in a fresh circular recently issued to the shareholders, reference is first made to the unfavourable financial results for the past year, and then to the existence of extraordinary difficulties, particularly in regard to the supply of materials and in connection with the erection of the lamps. It is also stated that the yellow colour of the light has not proved advantageous for many purposes, although a solution of the colour question has already been found, and that it likewise appears necessary to still further reduce the consumption of energy. It is also considered essential to extend the company's sales organisation and to open offices in the principal towns concerned, as too much time is said to be lost in concluding business through representatives. The Frankfort newspaper, in commenting on the circular, states that the company's shares were issued much too early, that the Moore light was not ready in a technical sense for general requirements, and that it is to be regretted that the public participated in the risk.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	
		£	£*		£	£*		Inc.
Aberdeen	Aug. 2	3,484	+ 340	9	14,851	+ 1,139	..	..
Ayr	„ 5	1,078	+ 67	12	5,040	+ 14	8	..
Bath	„ 5	1,994	— 183	31	25,428	+ 763	..	..
Belfast	„ 4	9,104	+ 977	18	63,240	+10,274	40	3
Birkenhead	„ 6	2,302	— 88	18	21,347	+ 814	13·7	..
Birmingham Corp.	July 29	18,091	+4,758	17	183,271	+16,810	56·8	..
Blackburn	.. ..	..	..	..	..	..	..	..
†Blackpool Corp.	„ 27	2,864	+ 275	..	2?,781	+ 3,882	..	..
Blackpool-Fleetw'd	Aug. 5	2,751	+1,283	5	6,925	+ 702	..	..
Bolton	„ 6	5,120	+ 80	19	47,700	+ 3,428	26	..
Bournemouth	„ 2	4,063	— 419	18	32,339	— 2,526	22	..
Bradford	July 29	11,420	+ 755	17	97,818	+ 8,334	56	1
Brighton	Aug. 6	3,079	— 551	18?	20,229	+ 1,087	9·5	..
Bristol	„ 4	14,749	+ 286	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	July 28	395	+ 40	30	6,486	+ 85	3·65	..
Barnsley	„ 28	367	+ 52	„	5,895	+ 338	..	..
Barrow	„ 28	711	+ 45	„	8,319	+ 568	5·37	..
Devonport	„ 28	1,206	+ 376	„	14,242	+ 1,964	8·85	..
Gateshead	„ 28	2,2.7	+ 141	„	30,840	+ 1,696	11·25	..
Gravesend	„ 28	602	+ 25	„	6,191	+ 173	6·5	..
Greenock	„ 28	1,592	+ 200	„	21,009	+ 2,668	7·25	..
Hartlepool	„ 28	711	+ 90	„	7,783	+ 678	6·72	..
Kidderminster	„ 28	311	+ 55	„	3,812	+ 255	..	..
‡Leamington	„ 28	509	+ 103	„	4,940	+ 173	..	..
Merthyr	„ 28	445	+ 28	„	6,164	+ 112	2·9	..
Metropolitan	„ 28	19,792	+4,478	„	259,952	+41,796	22	..
Middleton	„ 23	780	+ 78	„	9,990	+ 689	8·5	..
Mid.Joint Com'tee	„ 28	8,918	+ 163	„	171,989	+ 2,166	..	..
Oldham—Ashton	„ 28	1,211	+ 46	„	16,874	+ 488	9·13	..
Peterborough	„ 28	270	+ 22	„	3,725	+ 391	5·31	..
Potteries	„ 28	3,882	+ 202	„	57,582	+ 5,655	29	..
Rothesay	„ 28	1,500	+ 12	„	5,546	— 192	2·75	..
Southport	„ 28	777	+ 35	„	8,867	+ 368	8·17	..
S. Metropolitan	„ 28	2,036	+ 384	„	25,357	+ 1,422	..	..
Swansea	„ 28	2,461	+ 157	„	33,476	+ 2,241	12·5	..
Tynemouth	„ 28	850	+ 94	„	7,196	+ 24	3·75	..
Weston-s-Mare	„ 28	862	+ 290	„	3,886	+ 443	3	..
‡Worcester	„ 28	693	+ 47	„	8,562	+ 454	5·75	..
Wrexham	„ 23	210	+ 15	„	2,946	+ 102	..	..
Yorks. Wool. Dist.	„ 28	2,401	+ 186	„	31,299	+ 2,244	17	..
Miscellaneous	„ 28	523	+ 23	„	6,578	+ 352	..	..
Burnley	Aug. 5	2,838	+ 248	..	..	..	11·73	1
Burton-on-Trent	„ 6	621	+ 4	18	5,403	+ 441	6·6	..
Bury	„ 5	2,894	+ 452	18?	24,0?2	+ 2,029	22·5	..
Cardiff	July 29	5,422	+ 766	17	44,064	+ 4,786	..	..
Chatham and Dist.	Aug. 3	2,020	— 182	31	25,865	+ 112	14·98	..
Cork	„ 3	1,146	+ 77	31	15,333	+ 350	9·9	..
†Croydon	July 21	1,940	+ 260	..	30,432	+ 2,766	..	..
Darlington	Aug. 5	240	+ 21	19	4,211	+ 452	..	..
Darwen	„ 4	513	+ 49	18	4,935	+ 437	4·36	..
Dover	July 29	648	+ 96	17	4,488	+ 782	4·75	..
Dublin	Aug. 4	12,504	+ 385	..	88,674	+ 8,504	54·2	..
Dundee	„ 2	2,446	— 42	11?	13,970	— 126	15	..
East Ham	„ 5	2,151	— 118	18	20,229	+ 1,137	7·87	1
†Exeter	July 15	404	+ 80	..	5,296	+ 409	5·5	..
Glasgow	Aug. 5	36,092	+4,395	..	180,275	+15,597	98	·75
Hastings	„ 3	2,652	— 479	..	..	..	..	..
Huddersfield	.. ..	..	..	..	..	..	..	..
Hull	„ 5	5,762	+ 87	18	52,033	+ 2,522	14·5	..
Ilkeston	„ 3	282	31	18	2,431	+ 95	..	..
†Ipswich	July 29	527	— 63	17	7,905	+ 715	10·5	..
Kilmarnock	„ 29	565	+ 146	11	2,018	+ 241	4·25	..
Lancashire United	Aug. 2	2,856	— 30	31	41,145	+ 1,009	99	..
†Leeds	July 29	8,016	— 312	17	132,055	+ 9,833	108	..
Leicester	.. ..	..	..	..	..	..	..	..
†Leith	„ 29	751	+ 98	10?	7,738	+ 679	8·72	..
Liverpool	„ 29	24,475	+1,348	30	345,089	+18,575	116	2·5
‡L.C.C.	„ 26	90,255	+7,934	..	761,321	+55,157	141	9
London United	Aug. 5	14,774	—1,271	..	202,994	+ 7,076	..	..
Lowestoft	.. ..	..	..	..	..	..	3·5	..
Manchester	„ 5	32,295	+ 906	19	293,330	+16,223	133	..
Newcastle	„ 5	8,864	+ 190	..	79,135	+ 5,131	14·5	..
Newport	July 29	1,456	+ 80	17	12,742	+ 935	14·5	..
†Oldham	„ 30	2,052	+ 188	18	36,392	+ 2,211	28·5	·5
Portsmouth	.. ..	..	..	..	..	..	15·25	..
†Preston	„ 26	789	+ 54	17	13,518	+ 1,080	..	..
Salford	„ 31	10,021	+ 422	17?	87,019	+ 5,190	..	..
Sheffield	Aug. 8	12,738	+ 681	19	123,331	+ 8,295	40	..
Southampton	„ 2	2,836	+ 241	18	21,564	+ 2,750	..	..
Southend-on-Sea	„ 2	1,800	— 117	18	12,461	+ 1,489	..	..
†South Shields	July 29	709	+ 108	17	11,130	+ 1,510	..	..
Swindon	Aug. 2	315	— 18	18	2,334	+ 327	..	..
Tyneside	„ 2	1,272	+ 94	5	2,705	+ 116	..	..
Wallasey	„ 5	2,539	+ 123	18	21,073	+ 3,202	..	..
Walthamstow	„ 5	1,645	— 152	18	14,759	+ 1,179	9	..
West Ham	July 27	5,650	+ 663	17	47,547	+ 5,275	15·25	..
Wolverhampton	Aug. 2	2,035	— 25	18	18,198	+ 1,221	25	..
Cen. London Rly.	„ 5	8,568	—1,617	5	23,192	— 4,534	6·32	..
City & S. Lon. Rly.	„ 6	6,200	— 52	5	15,576	+ 6	7·26	..
Dublin-Lucan Rly.	„ 4	336	+ 68	5	844	— 46	7	..
G.N. and City Rly.	„ 5	2,706	+ 114	5	6,928	+ 241	3·5	..
†L'pool Overh'd Rly.	July 30	1,687	+ 120	..	6,481	+ 628	6·8	4·3
†Llandudno-Col. Bay	„ 29	575	+ 2	34?	7,922	+ 392	..	..
London Elec. Ry. Co.	Aug. 5	23,455	— 65	5	62,275	+ 1,305	21·25	..
Mersey Railway	„ 5	3,725	— 398	5	9,500	— 467	4·5	..
Metropolitan Rly.	„ 6	32,805	— 278	5	85,147	+ 429	24·5	..
Met. District Rly.	„ 5	21,107	+ 488	5	53,011	+ 2,967	24	..
Anglo-Argentine	„ 5	89,583	+1,145	..	1,510,698	+143,402	..	..
§Auckland	June 30	17,327	+2,469	52	210,167	+22,754	23·3	·6
Bombay (B.E.T.)	July 7	5,664	+ 628	27	77,101	+ 4,617	..	..
Brisbane	May	21,099	+2,009	..	..	..	..	..
Brit. Columbia Rly.	.. ..	..	..	..	..	..	..	..
Calcutta	Aug. 5	7,706	+ 745	..	..	..	..	..
Cape Electric T.Ld.	.. ..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	June	3,649	..	..	29,434	..	30·5	..
§Lisbon	.. ..	..	..	..	..	..	..	..
Madras	July 31	1,684	+ 191	..	23,130	+ 1,717	..	..
§Montevideo	July	22,012	+1,338	..	226,2.7	+12,894	..	..
Perth (W.A.)	Aug. 4	3,122	..	..	50,081	+ 5,756	22	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

THE August Bank Holiday recess did little to quiet the minds of those who had been troubled by the variety of foreign and domestic crises which assumed, perhaps, undue gravity in the middle of last week. Chief amongst the markets to feel the changes of sentiment has been the Home Railway, which, after being flat, took a turn for the better on the considerations of good earnings up to date, and the prospect of their being maintained during the current six months, but again gave way on the labour difficulties. There is more doing in Electric Lighting shares, and the Telegraph market still has as its principal object of interest the lively gamble which continues in Marconi shares.

The Electricity Supply market is strengthened by the declaration of a batch of good interim dividends, particulars of which have appeared, and are appearing, in other columns of this paper. The distributions seem to have aroused a little public interest, and investors have begun to take a hand in the shares. It was early in June that a slight buying movement started on account of the expectations as to the companies doing well by reason of the Coronation illuminations; but stagnation has been once more the prevailing conditions for the last six weeks. It cannot be pretended that there is much business going on, but the better tone of the market as a whole testifies to the greater willingness of people to put money into the shares.

The report of the British Electric Traction Company has aroused a considerable amount of criticism which, it seems to us, is entirely justified in attacking the scheme as not being sufficiently drastic. The market comment is on very similar lines. The scheme appears to us to be inadequate in dealing with the present situation, because to have brought the capital into line with the assets, the knife should have been applied for more deeply. It is, we submit, rather ridiculous to perpetuate the exaggerated Ordinary capital by splitting it up into Preferred and Deferred stock. Unless something like a financial miracle should happen, the Deferred will have to be wiped out sooner or later, and surely it would be better to face the situation boldly at once, rather than have another reorganisation of the capital hanging over the company. It is, however, not too late for the scheme to be re-modelled. Everybody would be glad to see this company flourishing and prosperous, but it seems to us hopeless to look for any return on the deferred stock under the plan proposed at present. There are other points for criticism, but none of them more important than this; and though the Ordinary shares may profit at the expense of the Preference for the time being, in the long run the directors' proposals will work out badly for both classes of shares, unless we are very much mistaken. The Ordinary and Preference shares have risen 5s. apiece on balance.

Further rises in the prices of the Mexican Light and Power issues are the feature of this group. The common stock went up 3, but lost 2 points later on; while for the bonds there is still a strong demand. Mexico Trams, on the other hand, have gone back, on news from various parts of Mexico showing conclusively enough that the country is still in an exceedingly unsettled state. Rio Trams have been inclined to droop a little, and Shawinigan Capital stock fell 2, but the firmness of the group, as a whole, is noteworthy, the strength appearing more particularly in the prior-charge descriptions.

In the Home Railway market, the spread of the dock strike at the end of last week led to renewed depression, which was afterwards wiped out by big rises throughout the list as the situation grew more pacific, only to be renewed on Tuesday after the holiday. Brighton Deferred stock is one of the favourite gambling counters for the reasons indicated here last week, the chairman's speech at the meeting showing how greatly the electrification had assisted in the excellent progress of the traffic receipts. After rising to 104, however, the price fell back to 103. East London Ordinary dropped to 5¾ because of the dock strike, and the definite electrification proposals have so far had little effect upon the prices of the company's stocks, which, of course, had risen in advance. Metropolitans and Districts, after being flat, only partially recovered, and the report of the Great Northern and City Company, reporting more favourable profits, had no effect upon the price of the shares, which remains at £1. In Central Londons there has been a further decline in the price of the Deferred, whilst City and South London lost a point, the market being anything but a good one.

Marconi's maintain their reputation for liveliness and strength; the price shows a further advance of 2s. 6d. Anglo-American Telegraph Deferred has gone back slightly in sympathy with depression in the American Railroad market. Other telegraph descriptions have been inanimate. Telephone varieties show a good deal of firmness. National Telephone Preferred stock, and the third Preference shares are rather higher. United River Plates and Chili Telephones have both improved. The manufacturing group is quiet. A seller of Willans & Robinson Ordinary put the nominal price down to the extent of ⅛ before he was able to realise his shares at a shilling apiece! Castner-Kellner's have hardened a trifle.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations August 8th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5½	8 — 9	..	6 2 3
Do. 4½ % Pref.	10	4½	4½	9 — 10	..	4 10 0
Do. Second 6 % Pref.	10	6	6	10¼— 10¾	..	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	101 —103	..	4 7 5
Brompton & Kensington, Ord.	5	10	10	8 — 8½	..	5 17 8
Do. 7 % Cum. Pref.	5	7	7	7½— 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City	5	5	5	3⅞— 4⅛	..	5 14 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅝— 5¼	..	4 7 10
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	5⅜— 4½	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	94 — 98	..	4 1 8
Chelsea, Ord.	5	4¼	5	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	98 —100	..	4 10 0
City of London, Ord.	10	7	7	12½— 12⅝	+ ⅛	5 10 8
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 10 0
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½— 91½	..	5 9 3
County of London, Ord.	10	5	5	7⅞— 7⅞ xd	..	6 7 0
Do. 6 % Pref.	10	6	6	11 — 11½ xd	..	5 4 4
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	5	Nil	Nil	3/16— 1/8	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2⅛— 2⅜	— ⅛	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	5½	6	4¼— 4⅜	..	6 6 4
Do. 5 % Cum. Pref.	5	5	5	4⅛— 4¼	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	95 — 98 xd	..	4 11 10
Hove	5	8½	9	6¾— 7¼	..	6 4 2
Kensington & Knightsbridge, Ord	5	8	9	6¾— 7⅛ xd	..	6 0 0
Do. 4 % Deb.	Stock	4	4	91 — 98	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	78 — 82	..	5 9 9
London Electric, Ord.	3	2	2	1⅜— 2	..	3 0 0
Do. 6 % Pref.	5	6	6	4¾— 5	..	6 0 0
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 0
Metropolitan	5	5	5	3⅞— 4⅜	+ ⅛	5 14 3
Do. 4½ % Cum. Pref.	5	4½	4½	4½— 4⅝	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	100 —105	..	4 5 9
Do. 3½ % Mort. Deb.	Stock	3½	3½	84½— 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96½— 98½	..	4 11 5
Newcastle-on-Tyne	5	4	4	3⅜— 3⅞ xd	..	5 8 3
Do. 5 % Pref., Non. Cum.	5	5	5	3⅞— 4⅜	..	5 14 3
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 — 104	..	4 16 2
Notting Hill	10	7½	8	..	..	6 5 6
Oxford	5	7	7½	6⅛— 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10	9 — 9½ xd	+ ¼	5 5 3
Do. 7 % Pref.	5	7	7	6¾— 7¼ xd	+ ¼	4 16 7
Do. 3½ % Deb.	100	3½	3½	84½— 86½	..	4 0 11
Smithfield Markets, Ord.	5	Nil	Nil	1⅛— 1⅜	..	Nil
South London, Ord.	4	5	5	2⅝— 3	..	6 13 4
Do. 5 % First Mort. Deb.	100	5	5	98½—101½	..	4 18 6
South Metropolitan, 7 % Pref.	1	7	7	1⅛— 1⅛	..	5 12 0
Do. 4½ % First Deb. Stock	100	4½	4½	97 —100	..	4 10 0
Urban, Ord.	5	5	5	⅛— 1	..	..
Do. 5 % Cum. Pref.	5	5	5	2⅜— 3	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	87 — 89	..	5 1 2
Westminster, Ord.	5	10	10	7¾— 8½	..	6 1 3
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅛	..	4 8 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛— 5⅜	..	5 4 4
Calcutta, Ord.	5	8	8½	6⅝— 7⅛	..	5 19 4
Do. 5 % Pref.	5	5	5	4⅛— 5⅜	..	4 13 0
Calgary Power, 1st Mort. Bds.	100	5	5	96 — 98	..	5 2 0
Canadian Gen. El. Com.	$100	7	7	110 —115	—1	6 1 9
Do. 7 % Pref.	$100	7	7	121 —125	+1	5 12 0
Cordoba Lt., Power and T., Ord.	1	2	3	⅜— ⅞	..	3 8 4
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	..	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Bonds	100	5	5	84½— 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	86 — 88	..	5 13 8
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	Nil	1/16— 3/16	..	..
Do. 6 % Pref.	1	6	6	13/16— 15/16	..	8 6 8
Kaministiquia Power, 5 % G. Bs.	$500	5	5	101 —103	..	4 17 1
Madras, Ord.	5	Nil	..	2⅝— 3⅛	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	95 — 97	..	5 3 1
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	90 — 91	..	5 10 0
Mexican Lt. & Power, Common	$100	4	4	89 — 91	+1	4 9 0
Do. 7 % Cum. Pref.	$100	7	7	110 —112	..	6 5 0
Do. 5 % 1st Mort. Gold Bds.	..	5	5	97½— 99½ xd	+1½	5 0 6
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	89½— 91½	..	5 9 3
Montreal, Lt., H. and Power	$100	6	7	171 —175 xd	..	4 0 0
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	45 — 47	..	10 12 10
River Plate, Ord.	Stock	9	10	218 —228	..	4 7 9
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	101½—103½	..	4 16 7
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	4	4	117 —119	—2½	3 7 3
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	103 —105	..	4 5 9
Toronto Power, 4½ % Deb.	Do.	4½	4½	99 —101	..	4 9 1
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	Nil	Nil	1⅛— 1	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	..	6	108½—110½	..	5 8 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	Nil	7⅞— 7⅞	..	Nil.
Do. 5 % Deb. Red.	Stock	5	5	98 —100	..	5 0 0
American Telep. & Teleg., Cap.	$100	8	8	139 —141	..	5 13 6
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph	Stock	3⅜	3⅜	67 — 69 xd	..	5 8 8
Do. 6 % Pref.	Do.	6	6	111½—112½	..	5 6 8
Do. Def.	Do.	25/-	30/-	25¾— 26	— ⅛	5 15 5
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	8	7	6 15/16— 7 1/16 xd	+ 1/16	4 18 3
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	87½— 89½	..	4 9 5
Cuba Telegraph	10	6	6	10¾— 11	+ ⅛	5 9 1
Do. 10 % Pref.	10	10	10	17¾— 18½	..	5 9 7
Direct Spanish Telegraph, Ord.	5	4	4	3¾— 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	8¾— 8¾	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	99 —101	..	4 9 1
Direct United States Cable	10	4½	4½	7⅞— 8⅛	..	5 7 5
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98 —100	..	4 10 0
Eastern Telegraph, Ord. Stock	Stock	7	7	136 —139	..	5 0 9
Do. 8½ % Pref. Stock	Do.	3½	3½	84 — 86	..	4 1 5
Do. 4 % Mort. Deb.	Do.	4	4	101½—103½	..	3 17 4
Eastern Extension	10	7	7	13½— 13⅝	..	5 1 10
Do. 4 % Deb.	Stock	4	4	100 —102 xd	..	3 18 5
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99½—101½	..	3 18 10
Globe Telegraph and Trust	10	5⅞	5⅞	10¾— 11½	..	5 4 5
Do. 6 % Pref.	10	6	6	13 — 13½	..	4 8 11
Great Northern Telegraph	10	18	18	31 — 32	..	5 12 6
Indo-European Telegraph	25	13	13	56½— 58½	..	5 11 1
Mackay Companies Common	$100	4	5	88 — 90	..	5 11 1
Do. 4 % Cum. Pref.	$100	4	4	75 — 77	..	5 3 11
Marconi's Wireless Telegraph	1	Nil	Nil	2⅛— 2⅜	+ ⅛	..
Monte Video Telephone, Ord.	1	6	6	7/16— 1/2	..	6 0 0
Do. 5 % Pref.	1	5	5	7/16— 1/2	..	5 10 4
National Telephone, Pref.	Stock	6	6	103 —105 xd	+ ½	5 14 3
Do. Def.	Do.	6	6	119 —122 xd	..	4 18 4
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10½ xd	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10½ xd	..	5 11 7
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5 7/16— 5 9/16 xd	+ 1/16	4 7 11
Do. 3½ % Deb.	Stock	3½	3½	98 —100	..	3 10 0
Do. 4 % Deb.	Do	4	4	98 —100	..	4 0 0
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	102½—103½	..	4 7 2
Oriental Telep. and Elec.	1	8	8	1 1/16— 1 1/8	..	4 8 8
Do. 6 % Cum. Pref.	1	6	6	1⅛— 1⅛	..	4 16 0
Do. 4 % Red. Deb.	Stock	4	4	87½— 89½	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99 —101	..	3 19 3
Reuter's	8	5	5	8⅝— 9⅛	..	4 7 9
Submarine Cables Trust	Cert.	6	6	131 —134	..	4 8 11
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99½—100½	..	4 9 7
United River Plate Telephone	5	8	8	7 5/16— 7 7/16 xd	+ 1/16	5 5 10
Do. 5 % Cum. Pref.	5	5	5	5⅛— 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1⅜— 1⅝	..	6 5 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	97½— 99½	..	4 0 5
West India and Panama Teleg.	10	Nil	¾	2⅝— 2⅞	..	2 12 2
Do. 6 % Cum. 1st Pref.	10	6	6	10⅝— 10⅞	..	5 12 11
Do. 6 % Cum. 2nd Pref.	10	14½	6	9½— 10½	..	5 17 1
Do. 5 % Debs.	100	5	5	101 —103	..	4 17 1
Western Telegraph, Ltd.	10	7	7	13⅝— 14½	..	4 18 3
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
Western Union Tel., 4 % Bnds. A	$1000	4	4	106 —109	..	3 13 5
Do. 4½ % Fdg. Bonds	$1000	4½	4½	101 —104	+1	4 6 7

* Unless otherwise stated, all shares are fully paid.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for		Closing Quotations August 8th.	Rise + or Fall —	Present Yield p.c.
	*	1909.	1910.			£ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	⅛ — 5/16	.	Nil
Do. 5 % Pref.	1	5	5	6 9/16 — 11/16	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5
Brit. Elec. Trac., Ord.	10	Nil	Nil	1/16 — 1/8	+ 1/16	Nil
Do. 6 % Pref.	10	1½	1½	3½ — 4½	+ 1/2	3 10 7
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Do. 4½ % 2nd Deb.	100	4½	4½	76 — 80	..	5 12 6
Central London Railway, Ord.	100	3	3	68 — 70	..	4 5 9
Do. Pref.	100	4	4	87 — 89	..	4 9 11
Do. Def.	100	2	2	49 — 51	—1	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1¾	1¾	31 — 32 xd	— ¼	4 13 9
Do. 5 % Pref., 1891	100	5	5	108 —110 xd	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —105 xd	..	4 15 3
Do. Do. 1903	100	5	5	102 —104 xd	..	4 16 2
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 7
Dublin United Trams, 6 % Pref.	10	6	6	12¾ — 13¼	..	4 10 7
Great Northern & City, Pr'f. Ord	10	Nil	Nil	1/16 — 1/8	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	Nil	..	..	Nil
Do. 4½ % Deb.	100	4½	4½	75 — 80	..	5 12 6
Isle of Thanet Trams, 5 % Pref.	5	1½	2½	2¼ — 2⅜	..	4 10 11
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	Nil	3¾ — 4	..	Nil
Do. 4 % Deb.	100	4	4	73 — 76	—1	5 5 3
Metropolitan Railway Consol.	100	1	1⅜	46 — 46½	—1/2	3 15 8
Do. Surplus Lands	100	2⅜	2⅜	66 — 68 xd	..	4 4 7
Do. 3½ % Deb.	100	3½	3½	92 — 4	..	3 14 6
Do. 3½ % Pref.	100	3½	3½	88 — 90 xd	+ 1	3 17 9
Do. 3½ % Con. Pref.	100	3½	3½	87 — 89 xd	..	3 18 8
Metropolitan District Ord.	100	Nil	Nil	26 3/32 — 27¼	— 3/4	Nil
Do. 6 % Deb.	100	6	6	145 —147	..	4 1 8
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 5
Do. 4½ % First Pref.	100	Nil	3½	90 — 92	..	3 10 8
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5½	31/32 — 1 1/32	..	5 6 8
Do. Def.	1	Nil	Nil	7/16 — 15/32	..	Nil
Do. 5 % Pref.	1	5	5	31/32 — 1 1/32	..	4 17 0
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	102½—104½	..	4 15 8
Potteries, Ord.	1	2	2	31/32 — 1	..	..
Do. 5 % Pref.	1	5	5	15/16 — 1	..	7 5 6
Do. 4½ % Deb.	100	4½	4½	88 — 91	..	5 18 11
South Metro. Trams, 6 % Pref.	1	3	6	1/2 — 5/8	..	10 3 0
Do. 4 % Deb.	100	4	4	73 — 78	..	5 15 5
Underground Elec. Railways 5 % Prior Lien	..	5	5	100½—101½	..	4 18 6
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	Nil	1	64 — 66	..	1 10 4
Do. Power House Debs.	100	..	4	101 —103	..	3 17 8
Yorkshire (West Riding), Ord.	5	Nil	Nil	1/2 — 3/4	..	Nil
Do. 6 % Pref.	5	Nil	Nil	2⅜ — 2¾	..	Nil
Do. 4½ % Deb.	100	4½	4½	82 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5	5½ — 5 5/16	..	5 3 6
Do. 2nd Pref.	5	5	5	4 15/16 — 5 1/16	..	4 18 9
Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Do. 4½ % Deb.	100	4½	4½	100 —102	..	4 8 3
Do. 5 % Deb.	100	5	5	100 —102	..	4 18 0
Auckland Trams, 5 % Deb.	100	5	5	102 —105	..	4 16 2
Bombay Elec. S. & Trams, Pref.	10	6	6	10¾ — 11¼ xd	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Do. 5 % 2nd Deb.	100	5	5	96½ — 98½	..	5 1 6
Brisbane Trams Invt., Ord.	5	8	8	6½ — 7	..	5 14 4
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	8	141 —145	..	5 10 4
Do. Pref. Ord.	100	6	6	119 —123 xd	+1	4 17 7
Do. 5 % Pref.	100	5	5	106 —119	..	4 11 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —108	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	101 —104	..	4 6 7
Do. 4½ % Con. Deb.	100	4½	4½	102½—104½	+1	4 6 2
Calcutta Trams, Ord.	5	4½	6	5⅜ — 6⅛	..	4 16 0
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	Nil	1/16 — 1/8	..	Nil
City Buenos Aires Trams (1904)	5	5	5	5⅝ — 5¾	..	4 5 1
Do. 4 % Deb.	100	5	5	94 — 97	..	5 3 1
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 —100	..	5 0 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —102	..	4 18 0
Kalgoorlie Elec. Trams	1	Nil	Nil	3/16 — 5/32	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	6	6	63 — 67	..	7 9 3
La Plata Elec. Trms, Prf.	1	6	6	1⅛ — 1 1/16	..	5 13 0
Lisbon Elec. Trams, Ord.	1	5½	5½	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	97 —101	..	4 19 0
Madras Elec. Tr. (1904), Deb.	100	5	5	95 — 98	..	5 2 0
Manaos Trams & Lt., 1st Deb.	100	..	5	90 — 93	..	5 7 6
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100 —102	..	4 18 0
Mexico Trams Com.	$100	7	7	120½—122½	— ½	5 14 3
Do. Gen. Con. 5 % Bonds	..	5	5	99 —100	..	5 0 0
Do. 6 % Bonds	100	6	6	99 —101	..	5 18 10
Para Elec. Rlys. & Lt., Ord.	5	..	10	7⅛ — 7½	..	6 13 4
Do. 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	99½—101½	..	4 18 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1/8 — 1/4	..	..
Do. 5 % 1st. Deb.	100	5	5	101½—103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅝	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	97 —100	..	4 10 0
Rio de Janeiro Trams	$100	1	4½	116 —117	— ¾	4 5 6
Do. 1st Mort. 5 % Bonds	..	5	5	101 —102	..	4 18 6
Do. 5 % Mort. Bonds	100	5	5	97⅜ — 98⅜	+ ⅛	5 1 3
Sao Paulo Tram, Lt. and P.	$100	10	10	180 —183	—1	5 9 3
Do. 5 % 1st Deb.	$500	5	5	103 —105	..	4 15 3
Singapore Trams, 5 % Deb.	100	5	5	83 — 87	..	5 15 0
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 98 xd	..	5 2 0
Un. Elec. Trams Monte Video	5	5	6	5¼ — 6	..	5 0 0
Do. 6 % Pref.	5	6	6	5 — 5⅛	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	102 —105	..	4 15 3
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	107 —109	..	4 2 7

MANUFACTURING COMPANIES.

Aron, Ord.	1	..	Nil	5/8 — 3/4	..	8 0 0
Do. 6 % Pref.	1	12	9	11/16 — 3/4	..	7 7 8
Babcock & Wilcox	1	24	26	5⅞ — 6⅛	..	6 1 0
Do. Pref.	1	6	6	1⅛ — 1⅜	..	4 0 0
B.I. & Helsby Cables	5	10	10	6⅞ — 7⅛	..	6 15 7
Do. Pref.	5	6	6	5⅞ — 6⅛ xd	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	96 — 99	..	4 10 11
British Westinghouse, Pref.	3	Nil	Nil	1/16 — 1/8	..	Nil
Do. Deb.	100	4	4	59 — 62	..	6 9 1
Do. 6 % Prior Lien	100	6	6	102 —104	..	5 15 5
Browett, Lindley, Ord.	1	Nil	Nil	1/6—2/-	..	Nil
Do. Pref.	1	Nil	Nil	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	Nil	1/16 — 1/8	..	Nil
Do. 7 % Pref.	2	Nil	Nil	1/16 — 1/8	..	Nil
Do. 4½ % Deb.	100	4½	4½	58 — 63	..	7 2 10
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	15	9 — 9½	..	7 18 0
Do. Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. Deb.	100	4½	4½	101 —103	+ 1/32	4 7 5
Castner-Kellner	1	14	17½	3¼ — 3⅜	..	4 17 0
Do. Deb.	100	4½	4½	102 —105 xd	..	4 5 9
Crompton & Co.	3	Nil	Nil	1/8 — 3/8	..	Nil
Do. Deb.	100	5	5	57½ — 67½	..	7 8 2
Dick, Kerr	1	6	5	13/16 — 15/16	..	5 6 8
Do. Pref.	1	6	6	1 1/16 — 1 1/32	..	5 9 7
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	Nil	9/16 — 11/16	..	Nil
Do. fully paid	5	Nil	Nil	1⅞ — 2⅛	..	Nil
Do. 4 % Deb.	100	4	4	67 — 71	..	5 12 8
Do. 5 % Second Deb.	100	5	5	78 — 81	..	6 8 5
Electric Construction	2	Nil	2½	1¼ — 1⅜ xd	..	6 3 0
Do. Pref.	2	7	7	1¾ — 1⅞ xd	..	7 4 4
Greenwood & Batley, Pref.	10	7	7	7½ — 8½	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8½ — 9	..	5 11 1
Do. Deb.	100	4	4	88 — 93	..	4 6 0
Henley's, Ord.	5	15	15	12½ — 12¾	..	5 16 6
Do. Pref.	5	4½	4½	4⅞ — 5⅛	..	4 7 10
Do. Deb.	100	4½	4½	106 —108	..	4 3 4
India-Rubber, G. & T.	10	10	10	11½ — 13½	..	7 8
Do. Pref.	10	5	5	9¾ — 10⅜	..	4 16 5
Telegraph Construction	12	17½	20	35 — 37	..	6 7 2
Do. Deb.	100	4	4	99 —101	..	3 19 3
Willans & Robinson	1	Nil	Nil	3/32 — 5/32	— 1/32	Nil
Do. Pref.	5	1½	Nil	1 — 1	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3 1

* Unless otherwise stated, all shares are fully paid.

Bank rate of Discount 3 per cent., March 9th, 1911.

NOTES ON POWER PLANT WORKING.

[COMMUNICATED.]

In the running of power plant it is always desirable that the engineers should be able to know very closely what it is costing to produce the article they supply. By this it is not meant that they should know next Saturday or next Monday what have been the manufacturing costs during the previous seven days, but that, if possible, they should know this minute the present rate of expenditure. It is not desirable to keep too elaborate statistics involving much clerical work.

Many workshop system organisers allow themselves to be carried away by these systems, so much so that some American shops have been, perhaps somewhat humorously, described as resembling offices rather than workshops, so busy has every man been filling up the forms and tickets essential to the system.

In a power house a very elaborate system is not necessary. Far too many statistics are sometimes kept or worked out. Economy of manufacture of electrical energy depends upon a few principal items. First and greatest in a station of any serious dimensions is the cost of coal. Oil will usually come next. Water may or may not cost money, and when it does not cost money the charge may be direct or indirect. Lighting is a charge which may be large or small, and after these items stores generally, once they have been cut down to a minimum, may be lumped together and the total watched.

Enough has been written on the subject of the purchase of coal on its calorific value to rouse men not only to the importance of this as a base of action, but to awaken in them the sense that other qualities than thermal units per penny also demand some recognition. It is a little difficult nowadays for a vendor of coal to come forward and, while admitting an inferiority on the part of his coal in the matter of thermal units, to claim that this is more than outweighed by other qualities. He would be regarded as plausible and yet he might be perfectly right. But this sort of truth lies with the station engineer to discover. Coal consumption can very well be known by some system of weighing more or less near to the actual point of user, the nearer the better for absolute work. The water evaporated can be known and doubly checked by a feed meter and a Lea recorder, the latter probably fully as accurate as the former. The Lea recorder is a particularly valuable instrument because by it can be known in a few minutes the answers to questions, which without the recorder have given us those long steam-engine tests which are so wearisome to make and cost so much, and are so apt to be deprived of much of their value by some mishap during the progress of the test.

The elaboration of oil separation plant in reciprocating engine stations sometimes seems to indicate that it might be better to throw away the water and use new water warmed in tubular heaters by the hot waste water.

It is certain that where water can be got from a well it will cost less than when purchased from the ordinary type of water authority. It is a poor pump and motor combination that will not pump water from a well at 50 per cent. mechanical overall efficiency, and the work done is simply calculable in foot-pounds from the height raised and the gallons per minute. To this cost must be added that of softening, which may or may not be equally chargeable to both purchased and pumped supplies.

The question of independent water supply has of late undergone some modification by reason of the fact that it is now possible to bore deep wells for considerably less cost than a few years ago, before the wide spread oil drilling industry had brought rapid drilling into prominence. A few years ago a bore hole of 1,000 or 1,500 ft. was regarded as a matter of two or three years' working, and progress was very slow. Now with a modern oil drilling rig depths of 100 and 140 ft. have been done in a day in the London area, and the average progress is much more rapid than was the case but a few years ago.

In throwing away greasy hot water, the cost balance includes on the one side the cost of pumping fresh water; the cost of softening it; the loss of heat; the interest on the pumping plant, and on the heat transfer plant. On the other side are the cost of coagulants, and the cost of make-up pumping, the interest on the smaller pumping plant, and on the oil separation plant. It does not seem to be generally known that very good oil separation can be effected by centrifugal machines; though they are not, perhaps, certain preventives of oil in boilers, they will recover most of the oil clean, and fit for use.

Since records have, as their primary object, the maintenance of economy at the highest figure, it appears unnecessary to work out results as some do in terms of I.H.P., B.H.P., and kilowatts, for these three items do not vary seriously between themselves, and except for occasional tests to find mechanical and electrical efficiencies, the cost per KW.-hour is the figure to be known.

A steam engine is a machine which for a certain use of steam will do a fixed regular amount of work; and more accurate results can be obtained to-day from observations of the instantaneous order than are possible to be got from a prolonged test. A recording instrument shows the rate at which feed water is being used. This rate does not exactly correspond with the rate shown by the wattmeter at the same instant of time, for the water recorder has a few seconds lag behind the wattmeter. But this lag can be closely approximated by observation of the recorder and by sudden change of load. Thus, let the load be changed or the L.P. rate of expansion be changed, and in a few seconds the effect will travel through the condenser and wet-air pump, and show at the recorder. Reverse the changes, and again in a few seconds the recorder will begin to tell the effect. Once determine the lag and afterwards the wattmeter can be read so many seconds ahead of the water recorder. The lag in time is merely the number of seconds which elapses between the time when the governor admits more or less steam to balance the changed resistance of the load, and the time when that steam, condensed to water, has found its way through the resistances of the condenser, through the air pump and into the recorder tank or V chamber. The change begins to be shown almost at once, but a few seconds longer are required for the complete effect to be visible in the float chamber.

It is not possible to watch such a recorder at work without becoming convinced of the extreme regularity with which a steam engine works, and of the futility and money waste of prolonged tests. Perfectly satisfactory tests can be made upon an engine as soon as it has arrived at normal condition. Thus it would conduce to inaccuracy to take a test reading within a few minutes of starting an engine, especially if it has only been warmed through while standing at rest. It takes some time for an engine to become fully hot, and during that time it will show larger steam consumption than when fully heated.

The present expensive tests on the engines at colleges are all very well in their way as exercises in taking readings, but for gaining information on the effects of changed conditions they are altogether too cumbersome. With the suggested method it would not take long to demonstrate the effect of an uncovered cylinder end, or side or of a bare length of steam pipe. Indeed, there is no limit to the statistics that may now be cheaply and quickly secured.

ELECTRICAL POWER AT THE RANDFONTEIN CENTRAL MINES.

A recent issue of the *Colliery Guardian* gave some interesting particulars as to the use of electrical power at the above mines, where there are five shafts. The following figures for horse-power were given :—

	Expected max. load.	Total installation.
Ore reduction works	5,710	7,255
Winding...	3,500	5,750
Air-compressors	2,400	3,200
Shaft pumps	1,000	1,575
Lights—		
8,000 incandescents, 140 arcs... ...	500	650
Workshops	150	200
Haulages	120	150
Miscellaneous	620	700
	14,000	19,480

The generating plant includes 24 Babcock boilers, using coal dust costing 6d. to 9d. per ton at the pit, and 10s. 6d. per ton delivered; these supply steam to two 1,000-KW., three 2,000-KW., and two 6,000-KW. Parsons turbines with condensing plant, driving 50-cycle three-phase alternators giving 6,600 volts between phases. These are designed to give their full output at ·7 power-factor, the regulation at unity power-factor being 18 to 20 per cent.

The H.T. switchgear is remote controlled, and mechanically or electrically operated according to size; it supplies 17 H.T. feeders, of three-core paper lead-covered and armoured cable laid direct at about 2½ ft. depth. Standard static sub-stations of 6,000 and 3,000-KW. capacities, consisting of 500-KW. single-phase transformer units are employed. The transformation ratios are 6,600/2,200 and 6,600/550 volts.

The capital cost of the whole plant was over £300,000, and for the power station only, £16 per KW. installed; a typical month's works costs, when over 5,000,000 units were generated, and nearly 4,700,000 units distributed, came to ·247d. per unit—fuel accounting for ·153d. of the total.

At each of the five shafts there are two Ward-Leonard type winders, one for men and the other for rock. The shafts are inclined and rectangular in section, and it is intended to limit the first stage of winding to a depth of 2,800 ft. The following details were supplied officially :—

Maximum speed when winding rock ...	2,000 ft. per min.
" " " men ...	1,600 ft. "
Total time occupied for winding rock ...	130 seconds.
" " " men ...	173 "
Interval for loading and unloading rock ...	28 "
" changing men	48 "
Weight of rock skip	4,740 lb.
" skip for men	4,000 "
" rock hoisted per trip	7,000 "
" men, 28 at, say, 150 lb.	4,200 "
" rope...	2·2 lb. per ft.

In the case of a three-phase hoist, the voltmeter indicates whether power supply is on or off, but nothing else; the ammeter under normal conditions indicates torque exerted. Under normal conditions, such as when exerting torque to retard speed, its indications cannot be relied upon unless the power factor is known.

With regard to the first cost of the three-phase and Ward-Leonard systems, the Ward-Leonard hoists were tendered at £8,500 each, as

compared with £6,500 for the three-phase type. Allowing for excavation and the cost of erection, the total cost worked out :—Ward-Leonard system, £10,700 ; three-phase system, £8,300 ; a difference of £2,400 in favour of the three-phase type.

Regarding working costs, those of maintenance will not differ much in the two cases. A comparison of power costs, obtained by constructing load curves indicating the speed and power required throughout the day's work, is as follows :—

	Total overall efficiency.	Units per shaft horse-power.	Units per trip.	Cost per trip at ·3d. per unit.
WARD-LEONARD—				
Rock hoisting ...	49·0 %	1·5	13·6	4·08d.
Men hoisting ...	31·0 %	2·36	13·0	3·9d.
Men lowering ...	—	0·159	0·875	0·2625d.
THREE-PHASE —				
Rock hoisting ...	47·5 %	1·55	14·17	4·2d.
Men hoisting ...	28·0 %	2·62	14·4	4·32d.
Men lowering ...	—	2·2	12·1	3·63d.

The costs per day would compare as follows :—

WARD-LEONARD.

470 trips with rock at 4·08d. ...	£7	19	9
54 trips with men at 3·9d. ...	0	17	6·6
54 trips lowering men at 0·2625d....	0	1	2·1
Total power cost per day ...	£8	18	5·7

THREE-PHASE.

470 trips with rock at 4·2d. ...	£8	4	0·5
54 trips with men at 4·32 ...	0	18	7·2
54 trips lowering men at 3·63d. ...	0	16	4
Total power cost per day...	£9	18	11·7

The number of men is taken at 1,500 per hoist. The net result shows a saving on the Ward-Leonard system of, roughly, £1 per day, or £300 a year, which, when established, more than makes up for the difference in the capital costs of the two systems, not to mention the advantages as regards operating possessed by the Ward-Leonard type. Another consideration is the effect of the two systems on the power station.

The electric winders for rock have drums 10 ft. diameter by 4 ft. wide, and are driven by two D.C. motors of 350 B.H.P. each. The brakes are operated by compressed air from the mains, a small auxiliary compressor automatically keeping the pressure above a fixed minimum. A tacheograph provides a record of each trip. Immunity from accident is obtained by utilising the indicators by a simple automatic device opening the circuit, and at the same time applying the brakes, whilst in case of failure of supply from any cause, the brakes are automatically brought into operation. The motor-generator set consists of a 2,000-volt A.C. motor of 800-H.P., driving a D.C. generator at 485 R.P.M. It is intended eventually to extend the electric hoists to the other mines of the group, thus bringing the number up to at least 20.

A NOVEL FORM OF SWITCHBOARD CONSTRUCTION.

A VERY interesting development in switchboard construction for high and medium pressures has recently been originated by the firm of Messrs. Vedovelli, Priestley & Co., of Paris, and in connection with the sub-stations on the North-to-South Underground Railway in Paris switchboards constructed in alabastrine, on the principle about to be described, have been installed. So successful has been the use of this material, which is a substance somewhat resembling cement, but taking longer to harden, and when hard closely resembling marble in durability and finish, that other installations have been effected, and the firm now builds a line of standard panels for high-pressure work, to which reference will be made.

The switchboards are constructed on the cubicle system ; that is to say, each piece of apparatus and each main conductor has its separate chamber or duct at the back or front of the board. Fig. 1 is an illustration of the switchboard of the Muette sub-station, which feeds the old section of the Champs-Elysées, at Paris, and which is constructed entirely with Vedovelli-Priestley apparatus and the alabastrine construction. The arrangement of the cubicles contained therein can be easily seen, the operator being protected from contact with the live parts by means of open metallic screens. This arrangement has been found to be most economical and safe, and the erection of the whole installation was carried out with the greatest facility.

As another example may be shown the cellular construction of alabastrine monoliths employed on the high-tension three-phase switchboard at the Necker sub-station of the North-to-South Underground Railway in Paris. This is seen in fig. 2, this being a corridor at the back of the board. The line voltage of 10,000 or 13,000 volts is transformed to a working secondary voltage on a three-wire system of 600 volts between outer and neutral, the rail being made the neutral conductor on the actual traction system, and both the high and low-pressure boards are constructed on the system mentioned. As the control and safety devices of an important traction system of this nature must be above suspicion, it is evident that alabastrine as a mode of electrical construction is worthy of attention.

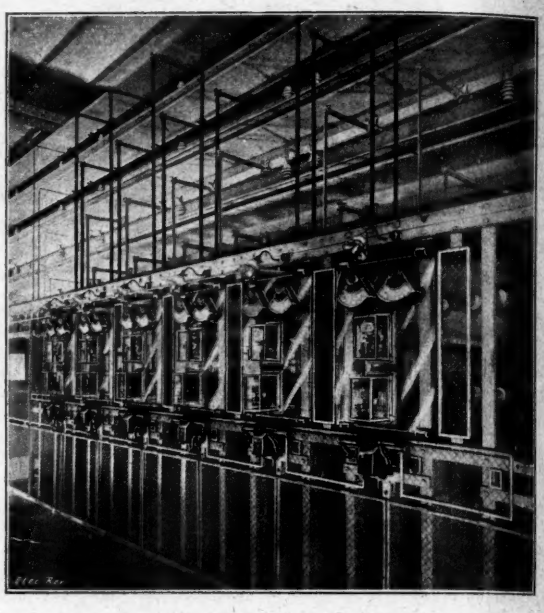


FIG. 1.—FRONT OF VEDOVELLI-PRIESTLEY SWITCHBOARD.

Reference has been made above to the very slow-setting nature of alabastrine. It takes about a month for a useful hardness to be attained, but the process continues until, at the end of about three months, an extraordinary durability is reached. In addition to its mechanical solidity, it possesses electrical insulating qualities in a very marked degree. In some recent tests on an alabastrine sheet or partition, a distance of 20 millimetres between contacts, and of a surface equally extended, was subjected to high voltage, and its insulation broke down at about 15,000 volts after about 15 minutes' subjection to pressure. The same test taken with porcelain on a space

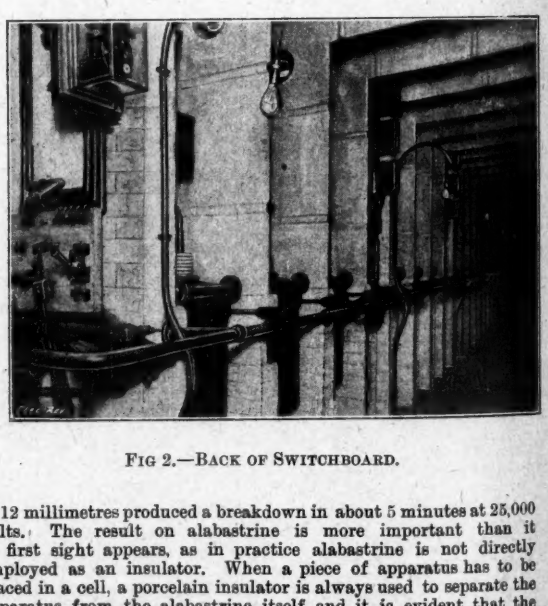


FIG 2.—BACK OF SWITCHBOARD.

of 12 millimetres produced a breakdown in about 5 minutes at 25,000 volts. The result on alabastrine is more important than it at first sight appears, as in practice alabastrine is not directly employed as an insulator. When a piece of apparatus has to be placed in a cell, a porcelain insulator is always used to separate the apparatus from the alabastrine itself, and it is evident that the layer of air which separates the apparatus from the alabastrine augments very considerably the insulating property of the system. One point, however, has to be observed—it is not adapted to carry water or to stand in water, and for this reason it is not used for culverts and similar work. It is preferable to keep it out of a humid atmosphere ; but with these precautions, and in the conditions usually found in power-house practice, it is an excellent material for switchboard construction.

The long time necessary for the complete hardening of the material has led to another development—the standardisation of various forms of alabastrine constructions for electrical purposes. For example, alabastrine bricks for building switchboards can be obtained in two standard sizes, one measuring 5·5 × 11 × 22 cm., the other being 4 × 8 × 16 cm. ; closed tubes of square cross-section varying from 25 cm. to 56 cm. side are made in metre

lengths; channels for the enclosure of high-pressure conductors of the cross-section shown in fig. 3, in which dimension *a* varies from 260 to 600 millimetres, and dimension *c* from 200 to 520 millimetres, are standardised in 2-metre lengths, while partitions of the shape shown in fig. 4 of height *a* ranging from 400 millimetres to 700 millimetres are used for general switchboard construction. In addition to this a complete range of monoliths is made, the most interesting examples of which are complete panels of the cellular type, each comprising all the apparatus for a transformer, feeder, generator or measuring panel as the case may be. A typical monolith, with the apparatus mounted thereon, is shown in fig. 5; this represents a panel containing a section of the main bus-bars at the top of the board, each in its separate duct, from which connections are taken through isolating links to the three poles of a three-phase oil-break switch, each phase being in

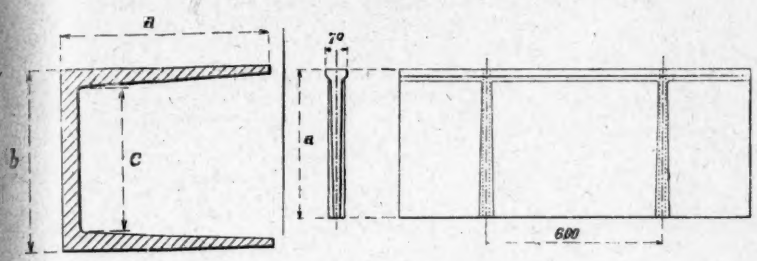


Fig. 3. Fig. 4.

Alabastrine Channel and Partition.

a separate oil tank. The lower part of the board has a throw-over switch, so that either of two cables may be utilised.

These monoliths are standardised to a uniform height of three metres, a width of 9 centimetres, and a depth of 9·5 centimetres, and are capable of dealing with working pressures up to 10,000 volts. The current-carrying capacity of the contacts is 150 amperes, and the power which can be dealt with by the circuit interrupters is about 2,000 KW. These figures, of course, refer to the standardised models, though there is no reason why alabastrine and porcelain insulators should not be applied to higher voltages, or why the monoliths should not be constructed for larger power units. An advantage of this form of construction is that a switchboard can be simply and quickly put together by ranging an appropriate series of monoliths side by side and connecting up the bus-bars and a few simple auxiliary connections.

SOME PROTECTIVE RELAYS FOR ALTERNATING-CURRENT CIRCUITS.

By KENELM EDGCUMBE.

(*Concluded from page* 165.)

Number of Relays Required for the Adequate Protection of Various Systems.—Whereas in the case of measuring instruments, it is only under normal conditions that their performance need be considered, with relays, on the other hand, it is particularly under abnormal conditions that their working must be irreproachable. For this reason, many of the methods of connection which are admissible in the former case are by no means advisable in the latter. As an example, a three-phase three-wire system with insulated neutral may be cited. It is well known that in such a case the sum of the three currents is always equal to zero, so that two transformers connected to three ammeters will indicate the currents in each of the three phases, and this is, in fact, the standard method of connection for such a system. It is shown in fig. 15, where C T_1 and C T_2 represent the current transformers, and A_1, A_2 and A_3 the three ammeters.

When, however, relays are substituted for these latter, it is always advisable to add a third current transformer in line 3, for the following reason. It is quite possible for the insulation of the neutral point of the generator, or of the winding in phases 1 or 2, to become very low, without this fact being apparent under ordinary working conditions. On the occurrence of an earth in main 3 (fig. 15) a heavy current may return to the generator without flowing through lines 1 or 2 at all, and thus neither of the relays would trip.

It may be argued that this is a hypothetical case, and one

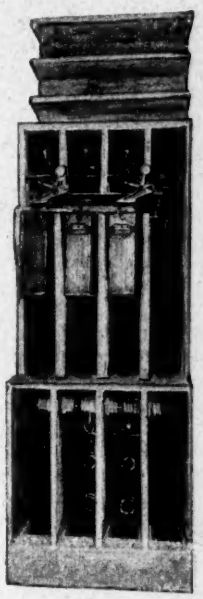


Fig. 5.—Standard Panel.

which is not likely to occur in practice. Unfortunately, it is precisely the least likely occurrences which have to by guarded against in devising protective devices, and probable in no part of the switchgear is economy so misplaced. To save a £5 note on a generator or feeder panel in this way

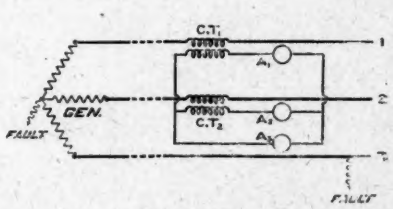


Fig. 15.

may mean endangering not only an expensive generating set but the entire station, and what is often of even greater importance, the continuity of supply throughout the whole system.

Another frequently unsuspected source of trouble may be mentioned as having recently come under the notice of the writer. It has reference to the installation of reverse relays

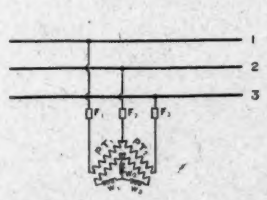


Fig. 16.

on a three-phase system. The usual connections are shown in fig. 16, where P T_1 and P T_2 represent two pressure transformers connected across the phases, and having the pressure windings of the reverse relays W_1, W_2 and W_3 joined up to them in star. Protective fuses F_1, F_2 and F_3 are inserted

between the transformer terminals and the lines. Suppose fuse F_3 to open circuit for any reason, then the idle secondary winding of P T_3 forms a link connecting the outer end of W_3 to the outer end of W_2, so that W_2 and W_3 are in parallel with one another, and in series with W_1, across the terminals of P T_1. As a result, the current in W_3 is in phase with the line voltage between phases 1 and 2, so that a current in phase 3, lagging by 30°, will have the effect of a reverse current 60° out of phase with that in W_3. Hence, since cos 60° = $\frac{1}{2}$, a forward load equal to twice that at which the relay has been set to trip will be enough to actuate it. This difficulty can be entirely overcome by using either three single-phase pressure transformers or one three-phase transformer, in place of the two single-phase shown in fig. 16. If the system has an earthed neutral, three single-phase transformers or one three-phase are always to be preferred, and to avoid complications due to triple frequency currents, they are best connected in star, with their neutral points earthed on both primary and secondary sides.

It should hardly be necessary to add a word of warning against the use of combined double and triple relays (that is to say, induction relays, consisting of a single disk acted upon by either two or three electro-magnets), were it not that these instruments are still occasionally put forward. In the case of a three-pole relay of this pattern, each of the electromagnets is connected to the secondary of a current transformer in one of the phases, so that an excess of current in all or any of the three phases will tend to rotate the disk and to trip the relay. Under normal conditions, each phase thus contributes one-third to the total torque, and the relay must therefore be set so that, with the three phases equally loaded, it will trip with the required overload. If, however, the fault occurs on one phase only, it is evident that the relay will not act until the current in that particular phase has risen to three times this value. For this reason, the protection afforded by such apparatus is most precarious.

The following table may prove useful as showing the number of relays and transformers required for the adequate protection of various systems. Two alternatives are given in each case, so that in less important installations, where expense is of primary importance, a more economical system may be adopted if this is thought advisable :—

System.	Number of relays overload or reverse.		Number of current transformers.		Number of pressure transformers for reverse relays.	
	Minimum.	Recommended.	Minimum.	Recommended.	Minimum.	Recommended.
Single-phase insulated	1	2	1	2	1	1
Single-phase earthed	1	1	1	1	1	1
Two-phase (4-wire) insulated	1 × 2	2 × 2	1 × 2	2 × 2	2	2
Three-phase (3-wire) insulated	1	3	2	3	2 single ph.	3 single ph. or 1 3-ph.
Three-phase (3 or 4-wire) earthed	2	3	3	3	"	"

In what has been said, so far, no attempt has been made to distinguish between the various types of fault which may arise—such, for example, as short circuits between phases, faults to earth, the seizing of motor bearings, and so forth. The outward and visible sign of all such faults is an excess of current flowing in the line, so that in general no attempt is made to differentiate between them, simple overload protection being provided for dealing with faults of every kind.

In many cases, however, it is of importance to be able to single out an "earth" for special treatment. This question has recently been brought into special prominence by the recommendations of the Home Office Committee, appointed to consider the working of the existing rules as regards the use of electricity in mines. This Committee strongly advocates the provision of some arrangement whereby the circuit shall be immediately opened on the occurrence of an earth, while not being disturbed by a mere overload, which may be quite temporary.

In the case of a three-phase system with insulated neutral, a dead earth may develop on one main without its presence being known to anyone, unless some form of leakage indicator

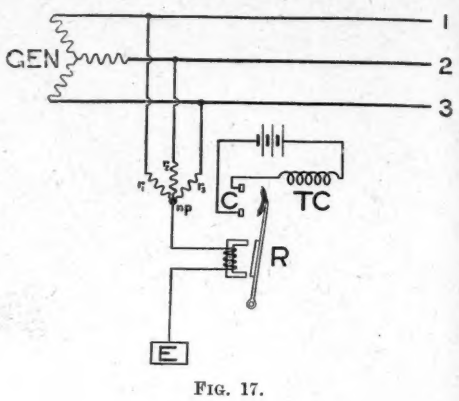


Fig. 17.

is in use. Fig. 17 shows the simplest form of automatic protection against earths on such a system. The resistances r_1, r_2 and r_3 are joined up so as to form an artificial neutral point $n\,p$. Between this and earth, a relay R is connected, which latter device may either be instantaneous in its action or be provided with a time lag.

Normally the neutral point $n\,p$ is at the same potential as the earth, so that no current flows through the coil of the relay R. If an earth develops on any main, this balance is disturbed, a current flows through R, the contacts C are closed and the tripping coil T C acts.

Instead of connecting the relay between $n\,p$ and earth, it may be joined between the neutral point of the generators and earth, provided this neutral point is accessible. On high-tension systems, a three-phase transformer takes the place of the resistances r_1, r_2 and r_3, these latter and the relay R being connected to the transformer secondaries.

When the neutral point is permanently earthed at the generating station, a fault to earth at once shows itself by a want of balance between the three currents. So long as the insulation is sound, the sum of the currents in the three lines at each instant will be zero, no matter whether the load be balanced or not. The writer, some years ago*, proposed to employ this fact as a means of protection by the use of a current transformer having three primary windings, one connected in each line, and a common secondary winding joined up to an indicator or relay. This arrangement has, since then, been employed by Messrs. Merz and Price and other engineers.

Mr. E. B. Wedmore has recently devised the very ingenious and satisfactory method of protection shown in fig. 18. It is applicable to all three-phase systems

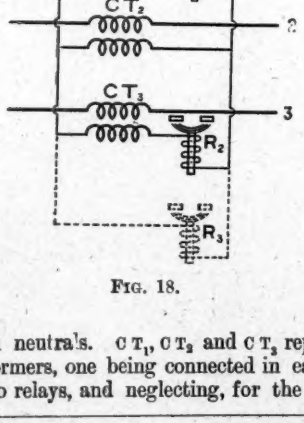


Fig. 18.

having earthed neutrals. C T_1, C T_2 and C T_3 represent three current transformers, one being connected in each line. R_1 and R_2 are two relays, and neglecting, for the moment, the

* Electrical Review, June 16th, 1905, page 968.

connections shown by dotted lines in the figure, it will be clear that an overload on any one or more of the phases will inevitably trip either R_1 or R_2.

These relays, therefore, provide adequate protection against overloads. Should an earth develop on any of the three lines, the current will return to the neutral point of the generator through the earth and a corresponding secondary current will necessarily flow through the relay R_3. With this arrangement accordingly, it is possible to adjust the two sets of relays quite independently of one another, as regards both tripping current and time lag. For example, the two overload relays may be set to trip with a 50 per cent. overload and a time lag of 20 seconds, whereas the leakage relay setting may be, at the same time, 25 per cent. of full load, and instantaneous in its action.

The advantage of being able to discriminate in this way between an earth and a pure overload will be at once evident, and it will be observed that the arrangement does not entail the installation of more than the three current transformers and relays which have been already advocated.

General Considerations.—There are two main methods of tripping in use. The one consists in closing an auxiliary continuous-current circuit through the circuit-breaker, while in the other the secondary current of a current transformer is employed. The first method is shown in fig. 2. It is of universal application, and, wherever an auxiliary source of continuous current is available, is strongly to be recommended. As a 200-volt or 500-volt circuit is usually employed for this purpose, it is advisable never to break the current at the relay contacts, but to provide a contactor which is automatically opened by the circuit-breaker when it comes out. It is clearly inadvisable to employ a potential transformer for the purpose of tripping, owing to the fact that on the occurrence of a fault the pressure may fail.

For the relay contacts, carbon rods are the most satisfactory, as they have no tendency to stick and are practically indestructible. For low-voltage tripping, however, laminated copper contacts are sometimes preferred, owing to their smaller resistance.

Fig. 19 shows the second method of tripping—namely, by means of a current transformer C T. The contacts C are normally closed, so that the trip coil of the circuit-breaker

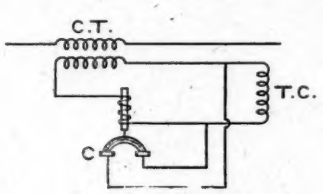


Fig. 19.

T C is short-circuited. So soon as a pre-determined current is exceeded the relay contacts open, and the secondary current from the transformer, having no alternative path, flows round the circuit-breaker trip coil and operates it. For the purpose of such a relay, it is essential that the resistance of the contacts should be low, and, for this reason, mercury cups are often used.

This system of current transformer tripping is only applicable to relays intended to protect against an overload. In the case of reverse relays protecting generators, it cannot often be employed owing to the fact that the relay setting corresponds, as a rule, to too small a current to satisfactorily work the circuit-breaker. In some other cases, such as where reverse relays are employed to protect feeders, this difficulty does not arise.

A further disadvantage of this system, as compared with that just described, is that it is not possible to trip the relays by hand with a view to seeing that everything is in satisfactory working order.

Most reverse relays are so deficient in power, as has already been seen, that it is not deemed advisable by the makers to allow them to close even the relay contacts direct. This is often done accordingly by tipping over a balanced contact arm, or by releasing a spring which presses the contacts together. Both these arrangements suffer from the great disadvantage of not being self-resetting, so that they have to be opened by hand before the circuit-breaker can be again closed.

To obviate this necessity, the form of contact shown in fig. 20 is fitted by Messrs. Everett, Edgcumbe & Co. to all their reverse relays. In series with the contact C, and the trip coil T C, is an auxiliary electro-magnet A M, which, when

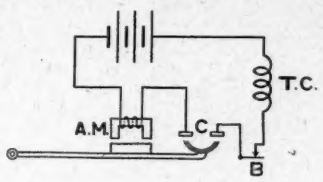


Fig. 20.

excited, draws up the iron keeper attached to the relay contact arm, and so presses the contacts C firmly into place. The lightest contact at C is enough to excite the auxiliary magnet, and a reliable contact is instantly made. The circuit-breaker in coming out opens the circuit at B, and the relay then resets itself and is ready to operate again. The advantages possessed by this arrangement, as compared with mercury cups on the one hand, and a non-resetting device on the other, are obvious.

As regards the most suitable time lags, no definite rules can be laid down, as the best interval must necessarily depend very largely upon the nature of the plant, the length of the feeders, the character of the load, and so forth. For this reason the time lag should be easily and accurately adjustable, and, as has already been said (p. 128), it is essential, in the case of relays intended for working in series, that the time lag curves should neither pass through the zero line, nor meet one another, however great the overload to which they are subjected.

In the case of feeder protection by means of overload time limit relays, it may be said that the time lag of the relays on the feeders leaving the power house should be made as long as possible, while those on the various feeders branching out from them should be set for shorter and shorter intervals as the more distant parts of the system are reached. This arrangement ensures that the relay nearest the seat of the disturbance shall trip before any of those between it and the power house. In a good many stations, settings of 15 or 20 seconds on a 50 per cent. overload are found to meet all requirements as regards outgoing feeders, but in other cases, very much shorter times, down to, say, 1½ seconds, are found necessary. This is particularly the case where synchronous machinery is in use in the sub-stations, since, if a long time-lag is given, a bad short-circuit may produce a hunting of the synchronous motors, which increases in severity until one or more of them drops out of step. In such cases, the only satisfactory method is to adjust the time lags empirically after the plant is running.

Artificial Rain.—A booklet has come to hand describing an invention by Mr. E. Olsson, of Buenos Ayres, called the artificial rain system combined with electricity for agriculture. Quotations from local newspapers are given regarding the system, which consists mainly in watering the plants under cultivation by means of revolving sprinklers. There is nothing new in this, and as might be expected, the plants so treated thrive. Unfortunately, however, electricity is dragged into the scheme, being applied by passing a current of a few amperes through the water in a tank; a report by a local "Quimico é Ingeneiro" and an "Electro-quimico" is quoted, describing the changes produced in the water, and certifying that "the water electrified with 5 amperes 110 volts was able to kill locusts perfectly. The same effect is produced by a current of 3 amperes 110 volts passing through water." We do not doubt this for a moment; in fact, we would willingly stake our reputation on the ability of London tap-water to kill any locust, with or without 3 amperes. "We also confirm that incandescent lamps were made to light and an electric bell to ring by means of a current which you conducted through the well-water," say the learned reporters. We accept this statement also. But we protest against the second title of Mr. Olsson's brochure—"Electrified Water as Food for Plants (patented)," and for the benefit of any Argentine reader who may be misled by the inventor's claims, and of the inventor himself, we must point out that this sort of "electrification" is utterly useless, and the idea is evidently based upon ignorance of electrical phenomena.

EXPERIMENTS ON THE INSULATING PROPERTIES OF LEATHEROID AND PRESSPAHN.

By D. H. OGLEY, B.Eng., Royal Technical Institute, Salford.

A large number of specimen pieces of the above materials having been selected at random, they were divided into four groups, which were then subjected separately to the following treatment:—Group A, vacuum dried; Group B, normal condition; Group C, exposed to damp atmosphere; Group D, impregnated.

The thickness of the material was as nearly as possible ·2 mm. and ·5 mm., and all dielectric strengths were taken between brass disks 1 in. in diameter. The frequency of supply being 50, National Physical Laboratory conditions were agreed with.

To eliminate as far as possible errors due to varying conditions, all the tests were taken on the same day, and the specimens were allowed to remain before being tested 10 minutes in the test-room atmosphere. The following results were obtained:—

Group A (Vacuum dried).

·2 mm. Presspahn. (Actual Thickness, ·22-·23).

Breakdown voltage.	*Time in seconds.*
2,310	45
2,520	40
2,000	Withstood this pressure for 10 minutes without breakdown.

·5 mm. Presspahn. (Actual Thickness, ·5-·53).

Breakdown voltage.	*Time in seconds.*
7,056	45
7,250	10
6,700	4 minutes.
6,000	10 minutes without breakdown.

·5 mm. Leatheroid (Actual Thickness, ·45-·47).

Breakdown Voltage.	*Time in seconds.*
7,980	45
8,100	25
7,890	27
7,100	4 minutes
6,900	10 without breakdown

Group B (Normal condition).

·2 mm. Presspahn (Actual Thickness, ·22-·235).

Breakdown Voltage.	*Time in seconds.*
2,310	45
2,100	50
2,600	10

·5 mm. Presspahn. (Actual Thickness, ·5-·53).

Breakdown Voltage.	*Time in seconds.*
7,100	45
6,500	120
6,400	180

·5 mm. Leatheroid (Actual Thickness, ·46).

Breakdown voltage.	*Time in seconds.*
3,528	45
2,700	60
2,510	90

Group C (Exposed to damp atmosphere).

·2 mm. Presspahn (Actual Thickness, ·21-·235).

Breakdown voltage.	*Time in seconds.*
2,000	30
1,930	120
2,200	20

·5 mm. Presspahn (Actual Thickness, ·48-·55).

Breakdown voltage.	*Time in seconds.*
6,130	10
5,540	35
5,400	60
5,880	30

·5 mm. Leatheroid (Actual Thickness, ·48-·99).

Breakdown voltage.	*Time in seconds.*
2,940	40
2,700	20
3,070	10
2,520	10 minutes without breakdown.

Group D (Impregnated).

·2 mm. Presspahn (Actual Thickness, ·31-·32).

Breakdown voltage.	*Time in seconds.*
10,400	3
10,000	4
8,900	30
6,300	3 minutes.

·5 mm. Presspahn (Actual Thickness, ·63-·68).

Breakdown voltage.	*Time in seconds.*
11,000	45
12,000	10
8,010	4 minutes.

·5 mm. Leatheroid (Actual Thickness ·52-·55).

Breakdown voltage.	*Time in seconds.*
11,610	45

Some samples of presspahn were placed in an oven and kept at 100° C. for a week, and the following results were obtained:—

·2 mm. Presspahn (Actual Thickness, ·2-·22).

Breakdown voltage.	*Time in seconds.*
2,180	30

(This result was obtained at six different places, showing great uniformity after treatment.)

2,016	2 minutes.
1,840	10 "

·5 mm. Presspahn (Actual Thickness, ·5-·53).

7,400	45 seconds.
6,500	3 minutes.
5,880	10 "

The treated material was impregnated with insulating shellac compound.

The results indicate that presspahn retains its insulating properties under varying conditions. Thus, after being in a damp atmosphere for a week, the puncturing voltage was very little lower than after being heated for the same length of time to 100° C.

Also, under normal conditions the dielectric strength is very little inferior to that obtained after heating.

Leatheroid, however, deteriorates rapidly as an insulator if damp, or even under normal conditions. For slot lining presspahn would therefore be more suitable.

After impregnating, the dielectric strength increases enormously for the ·2 mm. presspahn. Being the same for ·5 mm. presspahn and ·5 mm. leatheroid, it is obvious that the increase is merely due to the layer of compound, and not to any improvement in the material.

In the case of presspahn, with the exception of impregnating, special treatment seems of little value; but leatheroid requires heating to improve its insulating properties.

In all cases the pressure was brought up to breaking stress in as nearly as possible 30 to 45 sec.

Copper.—The decrease in the visible supplies for July has not been so heavy as was to be anticipated from mid-monthly returns. From Messrs. Merton's circular we learn that European visible supplies now stand at 68,025 tons, a reduction of 2,147 tons on the returns for the end of June. Stocks in Havre have increased 50 tons, making the total reduction for English ports 1,772 tons. Afloat from Chile are 575 tons more than at the end of June, while from Australia come 1,000 tons less. Rotterdam has increased its stocks 350 tons, and Hamburg is estimated to be holding 300 tons more, the net decrease in Europe being thus 1,122 tons. Supplies from North America to this country are above average, to all Europe slightly below. Spanish supplies are low to England and France, but above average to all Europe. Shipments from Chile are above average, from Australia slightly below. Deliveries are 38,791 tons to an average of 41,363 tons. American supplies dropped 3,922 tons during June, and the world's visible supplies 6,263 tons. The average decrease in European supplies for the past 12 months has been 2,456 tons, in the world's supplies for the past four months (*i.e.*, since the present falling-off set in) 3,534 tons.

Power from Peat.—The Gorlitz Maschinenbau Anstalt states that a system has been devised which affords a solution of the problem of utilising peat moors for the production of power that is of great importance. An installation of this kind has been erected at the Posen Exhibition, where the results of years of experiments are shown to the public for the first time, and a similar plant has been erected in Russia, and is in regular operation.

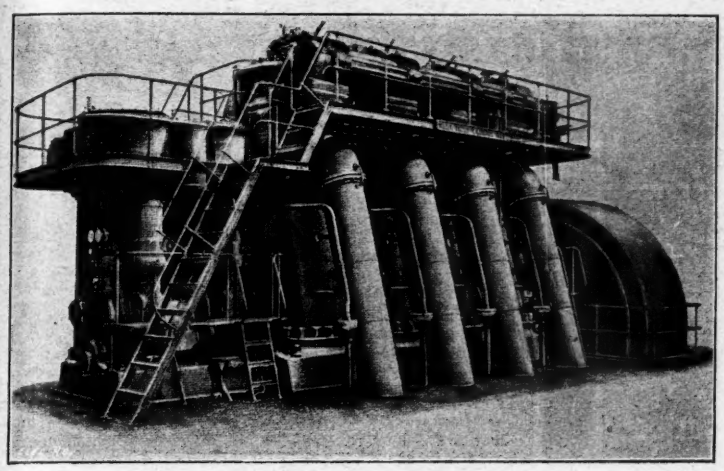
PROCEEDINGS OF INSTITUTIONS.

Modern Diesel Oil Engines.

By F. Schubeler.

(*Abstract of paper read at the Zürich Meeting of the* Institution of Mechanical Engineers, *July*, 1911.)

As regards reliability the Diesel oil engine can now be considered as fully equal to the steam engine, only the question of economy in each individual case deciding which of the two prime movers takes the preference. There was one principal difficulty which had to be overcome. The extremely high pressures and temperatures of the Diesel process put a limit to the dimensions of the cylinders, which will hardly exceed a diameter of 30 in. This corresponds to an approximate cylinder output of 300-400 H.P., assuming 150 R.P.M. of the shaft and the ordinary Otto cycle. It is not advisable to provide for more than six cranks, and a larger number would produce an inadmissible twisting of the shaft. Furthermore, such units require a great amount of space and would become extremely costly. These reasons called forth the necessity of seeking other means by which to increase the specific cylinder output of the ordinary single-acting Otto-cycle engine.



2,000-2,400 B.H.P. Two-Cycle Diesel Engine.

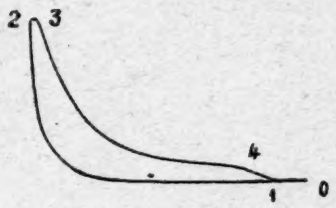


Diagram of Two-Cycle Diesel Engine.

For this there are the following possibilities:—

1. By making the single-acting Otto-cycle machine as a double-acting one.
2. By adopting the single-acting two-stroke cycle.
3. By adopting the double-acting two-stroke cycle.

The double-acting Otto-cycle cylinder under (1) corresponds approximately to a doubling of the cylinder output.

Almost the same result can be obtained by the procedure under (2), which, however, necessitates, as will be explained later on, the provision of special scavenging pumps.

The solution under (3) would theoretically even quadruplicate (in fact about 3·4 times) the output of the ordinary Diesel engine cylinder and mean the adoption of the usual working process of steam engines for the oil engine.

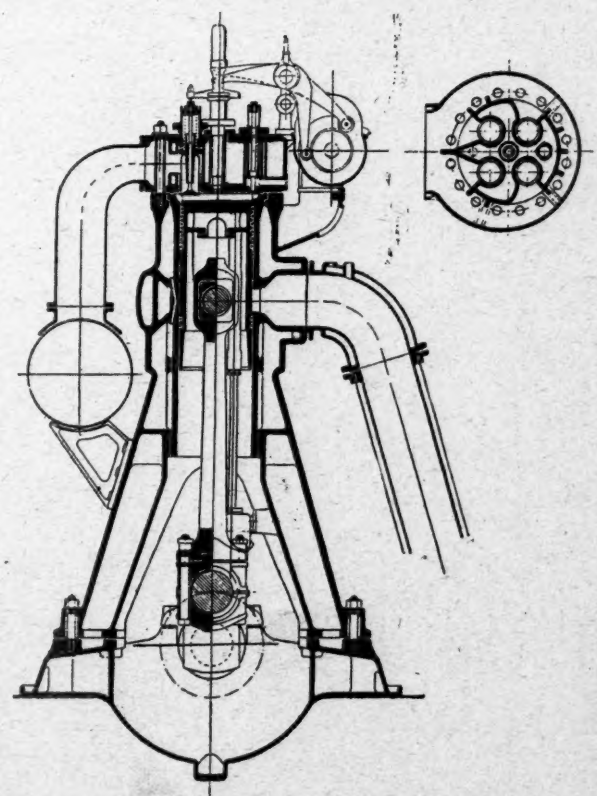
For smaller and medium size units the single-acting Otto cycle takes the preference, involving the smallest working strain on the cylinder. Although this type of engine necessitates a more or less frequent cleaning of the internal parts, especially of the exhaust valves, the author is informed that such machines have worked for periods of six to eight weeks without interruption, even in cement factories and mills.

The normal type of the single-acting four-stroke engine is a vertical one with trunk piston and without special crosshead. This has not only the advantage that the wear and tear of the piston is very slight, but also others with regard to the construction of the fuel valve and the symmetrical shape of the combustion-chamber. The space required is comparatively small, which is frequently an important advantage, and permits of good utilisation of the foundations upon which the enormous free forces of the cylinders are transmitted vertically.

The horizontal type, which is carried out by various firms, is specially suitable where small head-room is essential, and resembles in its construction that of the normal gas engine. The free forces are more awkward to deal with, and some difficulty also arises with regard to the formation of the combustion-chamber and the introduction of the fuel into the cylinder.

In the single-acting two-stroke cycle engine an exhaust valve is dispensed with, the piston uncovering, at the end of its outward or downward stroke, slots arranged in the cylinder wall through which the burnt gases escape from the cylinder. By means of a special scavenging pump an air pressure of about 4 lb. is produced. This lightly compressed air enters the cylinder through a valve arranged in the cylinder cover, drives the burnt gas out of the cylinder, and fills the latter again with a new charge of air as soon as the piston in its upward motion covers the slots. The air valve being closed, the air is compressed as in the ordinary Otto cycle engine, and also the fuel introduced in the same way at the end of the upward stroke. The whole process of driving out the gases, and the refilling of the cylinder take place within a very short time at the end of the outward or downward stroke. The length of the slots is about one-fifth of the stroke. With the ordinary Otto cycle machine two entire strokes are available for this process.

As to the two-stroke cycle process, this is the same as the well-known one employed with the highly-developed gas engine (Körting, Oechelhäuser). It is even more suitable for the Diesel engine. The two-stroke cycle gas engine scavenges also at the stroke end with fresh air, the difference, however, being that at this stage of the process the combustible mixture is introduced into the cylinder by a special gas pump, even before the exhaust slots are entirely closed. It therefore is impossible to prevent part of the combustible gases escaping unused in the exhaust, creating thereby a possible danger with the engine. With the Diesel engine the fuel is only introduced at the end of the compression stroke, thus preventing any losses of fuel and danger of preignition. The Diesel engine has, furthermore, the advantage that the rather bulky and power-absorbing gas pump can be dispensed with. It has also been ascertained that two-cycle gas engines show an increased fuel consumption at partial loads, whereas the two-stroke cycle Diesel engine has with smaller loads, consumptions which only differ slightly from those obtained by normal load. Of course, the consumption of the two-cycle engine is somewhat larger with respect

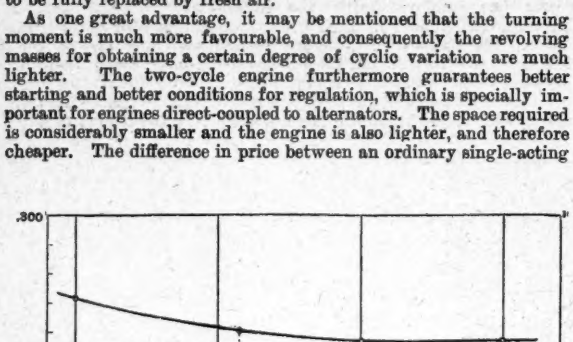


Vertical Section. Section through cover.

Two-Cycle Diesel Engine.

to the effective output than for the single-acting Otto-cycle engine. This must amount at least to the percentage of the energy absorbed by the air pumps. There must also be another increase due to the short cleaning and filling process of the cylinders, which does not allow as perfect scavenging as with the four-cycle engine. With the latter under its worst conditions about 7-10 per cent. of the cylinder volume (representing the compression space) is liable not to be fully replaced by fresh air.

As one great advantage, it may be mentioned that the turning moment is much more favourable, and consequently the revolving masses for obtaining a certain degree of cyclic variation are much lighter. The two-cycle engine furthermore guarantees better starting and better conditions for regulation, which is specially important for engines direct-coupled to alternators. The space required is considerably smaller and the engine is also lighter, and therefore cheaper. The difference in price between an ordinary single-acting



CONSUMPTION CURVE OF 400-B.H.P. MARINE DIESEL ENGINE.

four-cycle and a single-acting two-cycle engine for an output of 1,000 H.P. amounts to about 25-30 per cent., which figure would have to be considerably increased if larger units were compared. Furthermore, the lubricating oil consumption is somewhat smaller per horse-power, as the same cylinder and bearing dimensions are sufficient for producing about double the output.

The chief advantage of the two-stroke engine is the elimination of the exhaust valve (or two with larger units). Some difficulties cannot be avoided with the latter as soon as it attains large dimensions. Generally speaking, the fewer working parts coming into contact with the hot gas the better. The scavenging valve (or valves) in the cylinder cover may be dispensed with. Only a part of the cylinder slots are then used as exhaust slots, the remainder on the opposite side being used for the introduction of the scavenging air. A special shape is given to the top of the piston to guide the current of scavenging air and to guarantee a thorough removal of the burnt gases. The scavenging valve is thus removed from the high temperatures, and only the fuel valves and starting valves are exposed to them.

In the gas engine the stuffing-box problem may be regarded as solved. On the other hand, it must be admitted that with the Diesel engine the conditions to be dealt with are much more unfavourable, only to mention the higher pressure. It will therefore be preferable to avoid the difficulties with the stuffing box in the first instance, and to develop the new type on the lines of the single-acting four-stroke cycle engine.

A large number of the component parts remain the same for either type of Diesel engine, especially the fuel pump, fuel valve, air pump, piston, &c. The air pumps are to-day generally carried out as two or three-stage piston pumps with inter-coolers. Whereas smaller units have as a rule an air pump attached to each cylinder, driven by a lever from the connecting rod, it is a general practice to provide for larger units one large common air pump producing the injection air for three or more cylinders. The pump may be arranged either horizontally or vertically at one end of the bed-plate. This arrangement reduces the number of engine parts to be controlled and also the first cost. The valves are generally metallic ones, which alone are able to stand the high temperatures.

Messrs. Sulzer Bros. use the crosshead of the scavenging pump as low-pressure stage for the injection pump.

For lubricating the cylinders, special small oil pumps, that is, one for each cylinder, are provided. For bearings, connecting rods, &c., forced lubrication is generally advocated. The pump for the forced lubrication is driven direct from the shaft, and may be a piston or cog-wheel pump. The engines fitted with forced lubrication are totally enclosed. The cylinders are always cooled, but the pistons only from a certain size upwards. The water is generally led to the engine by gravity and only under a small head. A very simple arrangement for the piston cooling, which does not require any stuffing-box, and the working of which is absolutely reliable, deserves mentioning. With this arrangement the water does not entirely fill the cooling space of the piston, the water being only squirted against the highly-heated surfaces and draining off through a pipe which surrounds the spray pipe. By this arrangement all additional pressures and strains are eliminated. The exhaust valves for small engines are not cooled. Some firms use no cooling device even for large engines.

In practically all types the fuel-valve is operated through levers and rollers by cams fixed on a side shaft, which open the valve during 10-15 per cent. of the stroke, irrespective of load. The amount of fuel allowed by the regulator for any specified load accumulates around the fuel-valve spindle in a space filled with the highly compressed air, which, at the opening of the spindle, forces the oil through an atomiser into the cylinder. At smaller loads the regulator acts upon the fuel-valve in such a way as to reduce the amount of oil. The fuel-pump has a constant stroke, and the regulating of the fuel quantity takes place by the governor acting upon the suction valve, through which part of the fuel can flow back into the suction chamber. If a greatly reduced oil quantity is delivered to the fuel-valve, or, in other words, at small loads, it may happen that no ignition is effected, probably on account of the great air surplus extinguishing the forming flame. To avoid this the air pressure has to be reduced at smaller loads, which is done by hand in the case of smaller engines. Should this regulation be forgotten no danger arises with the engine, the result being only a decrease in the number of revolutions until the regulator again delivers a somewhat increased amount of fuel For larger engines, and especially where the conditions for synchronising are more stringent, the regulation of the injection air is done automatically by the regulator.

There is a large selection of cheap liquids available for fuel, the most important being: Crude mineral oils, mineral oil residues (crude naphtha, mazout), also gas oils, that is, intermediate products of oil refineries from which the lightest constituents, such as benzine and petroleum have been distilled, and the gas oil-tars of water-gas works. More recently it has been found possible to utilise the by-products of the distillation of coal and paraffin, tar, solar and paraffin oil. Explosions or danger of fire on account of the high flash-point are eliminated, and any quantities of such fuel may be stored without danger and without being subject to legal restrictions.

For standard low-speed single-acting four-cycle engines the number of revolutions lies between 150 and 300 at respective capacities of 1,000 and 15 H.P. These engines have the best fuel consumption, but have also the disadvantage that they are heavy and expensive. For this reason a single-acting multiple cylinder high-speed four-stroke cycle engine was designed, which is especially suitable for direct coupling to dynamos. The speed varies between 220 and 350 R.P.M. for outputs varying between 1,000 and 100 H.P. These high-speed types are just as reliable in service as the low-speed types. They have, however, a slightly higher fuel consumption. On account of their smaller first cost they are especially suitable where the Diesel engine is intended as a standby.

Single-acting two-stroke engines with outputs ranging between 700 and 3,000 H.P. are made with speeds of 160-140 R.P.M.

The calorific efficiency, with respect to mechanical output, may attain 30-40 per cent.; 25-30 per cent. is lost in the cooling water and the rest is contained in the exhaust gases. Of the latter heat about 20 per cent. can eventually be utilised for heating purposes, and in adding also the heated cooling water the total efficiency of a Diesel unit may go up to 80 per cent., which is certainly remarkable. Messrs. Sulzer Bros. have brought out a special waste-gas utiliser.

With regard to the actual costs per B.H.P.-hour, assuming a fuel price of 50s. per ton (which is certainly an outside figure) this will amount to about 0·11d. to 0·13d., or about 0·16d. to 0·2d. per KW.-hour. These figures are the actual figures maintained during actual service.

The Heating of Cables with Current.

By S. W. MELSOM, A.M.I.E.E., and H. C. BOOTH.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *June 11th*, 1911.)

THE object of this paper is to describe an investigation which was made at the National Physical Laboratory, at the request of the Wiring Rules Committee of this Institution, in order to determine the temperature rise and current density for a given temperature rise in cables of various sizes and with different types of covering.

Lengths of 40 ft. of various sizes of cable were tested, the smaller rubber-covered cable being tested when laid under various conditions, such as in wood casing, iron tubing, &c.

The insulation of the cables was of the standard pattern, the paper-insulated ones being lead-covered, and the rubber-insulated (with the exception of the 0·3 sq. in., which was only rubber-covered and taped), being taped, braided, and compounded. The rubber-covered cables marked A on the curves, and the paper-insulated lead-covered cables marked E, were in each case laid out flat along the wooden

TABLE I.

Diameter of cable.	Total area of both cables.	Area of inside of tube.
0·23 in.	0·08 sq. in.	0·33 sq. in.
0·40 in.	0·25 sq. in.	0·60 sq. in.

floor of the room, the lead and return being close to and touching each other. The concentric paper-insulated lead-covered cables, F_1 on the curves, were laid straight out along the floor, the current being led into the inner and returning by the outer lead. In the case of the rubber-covered cables in casing, marked B on the curves, the casing used was in each case twin and of the standard size for the various cables. The casing in some cases allowed of a rather larger air-space than in others. The ideal condition, from the point of view of dissipation of heat, is to have the cable nicely filling the

groove. The casing was laid flat along the floor. Observations made with it screwed to a board and supported on one edge, with the wires one above the other, showed no difference whatever from those made with the casing laid flat and with both wires in the same horizontal plane.

The iron tubes used were supplied by the Wiring Rules Committee for the various sizes of cables. In each case both the lead and return cables were drawn into the same tube. The dimensions of the tubes and the size of the cables are given in Table I. It will be seen that there was a considerable amount of air-space inside the tubes which would tend to retard the dissipation of heat.

The cables marked C on the curves were drawn into the iron tubes and laid staight out along the floor. In the case of those marked D and D′ the tube was embedded in a block of plaster running the whole

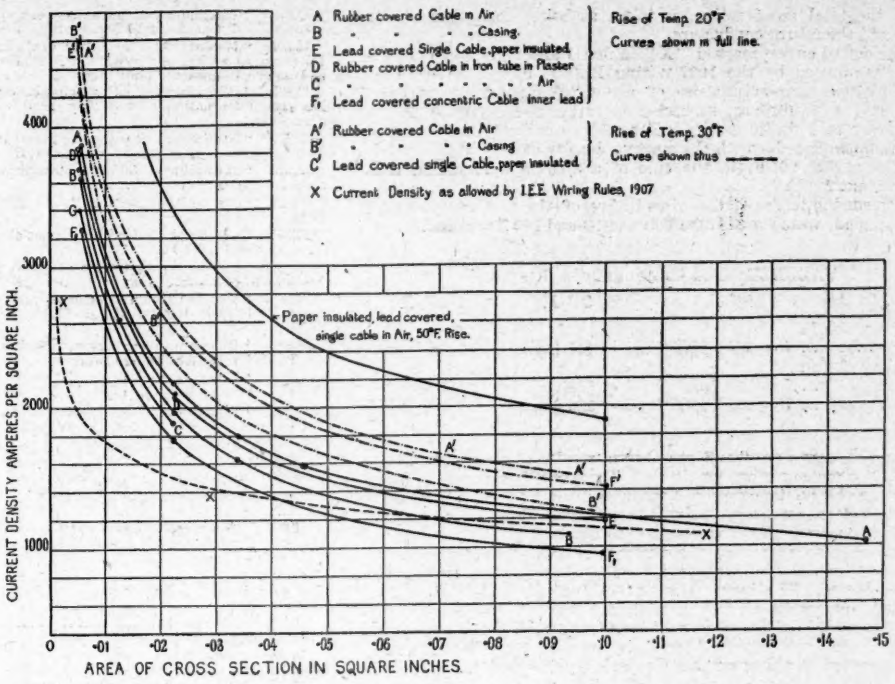

A Rubber covered Cable in Air
B " " " Casing.
E Lead covered Single Cable, paper insulated.
D Rubber covered Cable in Iron tube in Plaster
C " " " " " Air
F1 Lead covered concentric Cable inner lead
Rise of Temp. 20°F
Curves shown in full line.
A′ Rubber covered Cable in Air
B′ " " " Casing
C′ Lead covered single Cable, paper insulated
Rise of Temp. 30°F
Curves shown thus ——
X Current Density as allowed by I.E.E. Wiring Rules, 1907
Paper insulated, lead covered, single cable in Air, 50°F. Rise.
CURRENT DENSITY AMPERES PER SQUARE INCH.
AREA OF CROSS SECTION IN SQUARE INCHES

FIG. 1.

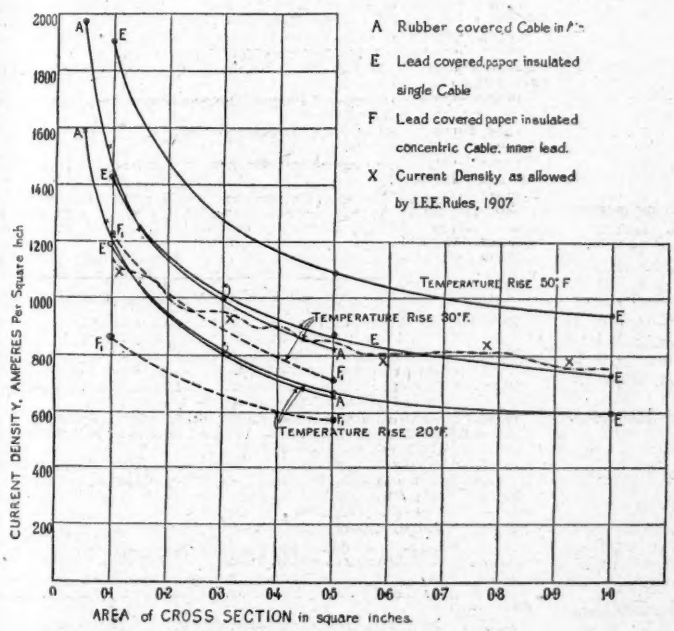

A Rubber covered Cable in Air
E Lead covered, paper insulated single Cable
F Lead covered paper insulated concentric Cable, inner lead.
X Current Density as allowed by I.E.E. Rules, 1907
TEMPERATURE RISE 50° F
TEMPERATURE RISE 30°F.
TEMPERATURE RISE 20°F.
CURRENT DENSITY, AMPERES Per Square Inch
AREA of CROSS SECTION in square inches.

FIG. 2.

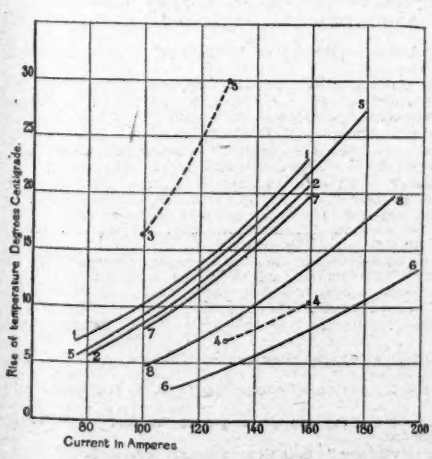


FIG. 3.

Curve No. 1.—Paper-insulated lead-covered cable laid out along floor.

Curve No. 2.—Rubber-covered, in iron tubing, each conductor in separate tube.

Curve No. 3.—Rubber-covered, lagged with blanket along its whole length.

Curve No. 4.—Rubber-covered, laid inside a ventilating shaft, along which a current of air at about 16° C. was being drawn by a fan.

Curve No. 5.—Solid bare copper conductor, of the same cross-section as the stranded cable, suspended in still air from insulator supports.

Curve No. 6.—Paper-insulated lead-covered cable buried direct in wet earth 4 ft. down.

Curve No. 7.—Paper-insulated lead-covered cable enclosed in 3" earthenware pipe and buried, same as No. 6.

Curve No. 8.—Rubber-covered cable in earthenware troughing filled in with bitumen and buried, same as No. 6.

length of the tubes, the plaster being 4 in. deep by 6½ in. wide.

The increase of temperature of the cables was determined by measuring the increase of conductor resistance.

The temperature coefficient of the cables was determined over the range of temperature covered by the tests, and is expressed by the formula—

$$R_t = R_{15}\{1 + 0{\cdot}0040\,(t - 15)\},$$

where R_{15} is the resistance of the conductor at 15° C. and R_t its resistance at t° C.

For the cables to which the wiring rules would apply there is little, if any, difference between the heating with direct and with alternating current.

Generally the current-carrying capacity of the rubber cables for a temperature rise of 20° F. is about 10 per cent. less when they are run in casing than when they are laid out along the floor—*i.e.*, in air (the latter, of course, approximates to the conditions of cables cleated to a wall or in a wood chase). There is very little difference between the rubber and paper-insulated cables when laid under similar conditions. The difference between rubber cable in casing and in iron tube in air (*i.e.*, laid along the floor) is very small. When, however, the iron tube is embedded in plaster the cooling is distinctly better, the curve being nearly the same as that obtained with the lead-covered single cable.

Figs. 1 and 2 are curves showing the result for the whole series of cables tested in current density per square inch of conductor for a given temperature rise.

Each of the cables examined was run with a steady current until a final maximum rise of temperature above that of the surrounding air was attained. The time required for this varied according to the size of the cable, from two up to five or six hours.

It was found that in certain cases—*i.e.*, single rubber-covered cables in air and in wood casing and paper-insulated lead-covered cables, both single and concentric—the connection between cross-section and current density could be fairly represented by a formula of the type $i = K\,(D/s)^n$, where n is a constant and K depends on the system of units adopted and the amount of the temperature rise. If i is the current density in the copper conductor in amperes per square inch, s the cross-section of the copper in square inches, and D the diameter of the outside covering of the cables in inches, the following table shows the value of these constants in the cases indicated.

For concentric and twin cables the formulæ are the same as for lead-covered single cables

if s, the total cross-section, is taken as being both that of the lead and the return conductors.

The dotted curves marked "X" in figs. 1 and 2 give the current-density allowed by the 1907 Wiring Rules. It will be seen that this gives a temperature rise of about 20° F. for cables of from 0·05 sq. in. to 0·15 sq. in. rising to rather more than 30° F. for cables up to 1 sq. in. section. For cables smaller than 0·05 sq. in. the temperature-rise with the current density at present allowed is much less than 20° F. (in the case of a 3/18 cable in casing it is only about 7° F.).

The conductivities of the wires in five of the cables were tested, and they all were found to be between 99 and 100·3 per cent.

TABLE II.—For Temperature Rise of—

Type of Cable.	20° *F.*	30° *F.*	50° *F.*
Rubber covered in air ...	... $i = 364\ (D/s)^{0·616}$	$i = 457\ (D/s)^{0·616}$	—
Rubber covered in casing	... $i = 309\ (D/s)^{0·66}$	$i = 358\ (D/s)^{0·66}$	—
Lead covered	... $i = 429\ (D/s)^{0·50}$	$i = 536\ (D/s)^{0·50}$	$i = 688\ (D/s)^{0·50}$

In the curve on fig. 3 are shown results obtained with 19/14 cable laid under various conditions. These results were preliminary, and the observations were not made so accurately as in the case of those before described. It will be seen that there are very large differences between the various methods of laying.

The extent to which the nominal rating of cables might be modified where the load is intermittent in character was also investigated. The larger sizes of cables only attain their final steady temperature after running for some hours; as a consequence of this effect, cables which are only working intermittently may be run considerably above their normal rating without at any time exceeding the maximum temperature rise permissible.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

AUSTRALIAN COMMONWEALTH.—With reference to the notice which recently appeared in the Electrical Review, regarding a revision of the Australian Customs requirements as regards the declaration of origin of goods imported into the Commonwealth for entry under the British Preferential Tariff, the Australian Customs Authorities have now issued a decision in which it is notified "that, in connection with the British Preferential Tariff of the Commonwealth, it has been decided that goods in which all manufacturing processes are performed in the United Kingdom, from unmanufactured raw material of foreign origin, are entitled to preference, irrespective of the proportion of the value produced by British labour.

"The wording of paragraph 2 of the Certificate required in connection with shipments of British goods for which preference is claimed is to be so interpreted."

Note.—For purposes of reference it may be stated that paragraph 2 of the Form of Certificate which is required to be produced with entry and invoices of goods entered under the British Preferential Tariff reads as follows:—

(2) That every article mentioned in the said invoice has been either wholly or partially produced or manufactured in the United Kingdom.

Samples liable to Duty.—A Customs Order (No 1,432), dated June 14th, 1911, has been issued stating that samples of merchandise are frequently sent by English manufacturers to residents of the Commonwealth. These samples are posted in consignments of some hundreds. It has been decided that in such cases duty is to be charged notwithstanding that the amount to be collected on an individual package does not exceed 1s.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

16,874. "Methods of producing electrical oscillations." W. H. Eccles and A. J. Makower. July 24th.

16,875. "Contact breakers for use in electric ignition systems of internal combustion engines." B. Brooks and F. H. Alston. July 24th.

16,878. "Distributors of magneto-electric machines for internal combustion engines." B. Brooks and F. H. Alston. July 24th.

16,894. "Memorandum and like appliances for use in connection with telephone and other purposes." E. F. M. Branson and F. H. Bowden (trading as Branson & Bowden). July 24th.

16,902. "Manufacture of magnetic electrodes." Chemische Fabrik Buckau. (Convention date, July 22nd, 1910, Germany.) July 24th. (Complete.)

16,907. "Earthing devices for electrical circuits." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke, Germany.) July 24th. (Complete.)

16,919. "Reversing switches for electric motors." Easton Lift Co., Ltd., and J. Huggett. July 24th.

16,923. "Electric lampholders." A. Rickards and A. C. Beale. July 24th.

16,952. "Glowing body for incandscent electric lamps." W. F. Mohr and F. Hansen. July 24th.

16,954. "Telephone instruments (receiver)." E. C. R. Marks. (G. R. Webb, United States.) July 24th. (Complete.)

16,955. "Transmitter for telephones and other sound transmitting instruments." E. C. R. Marks. (G. R. Webb, United States.) July 24th. (Complete.)

16,956. "Telephone instruments, including transmitters." E. C. R. Marks. (G. R. Webb, United States.) July 24th. (Complete.)

16,962. "Electromagnetic circuit breakers." Compagnie des Compteurs Aron. (Convention date, July 27th, 1910, France.) July 24th. (Complete.)

16,968. "High-pressure current distributors for electric ignition apparatus." W. Heyer. (Convention date, July 23rd, 1910, Germany.) July 24th.

16,986. "Multiple contact in thermo-electric elements." P. Ferra. July 25th.

16,992. "Process and arrangement for forming an electric arc." B. Duschnitz. (Convention date, July 29th, 1910, Germany.) July 25th. (Complete.)

17,006. "Wind power electric storage installations or apparatus." W. P. Perry. (Divided application on 13,480, of 1911. June 6th.) July 25th.

17,007. "Electrically-heated cooking apparatus." W. P. Perry. July 25th.

17,020. "Method of effecting telegraphic or telephonic communications between distant points at sea or between a ship and the shore, or across a strip of water." J. R. Quain and F. L. Roudebush. July 25th.

17,027. "Telephone receiver of the radiating field type." A. Vojen. (Convention date, August 30th, 1910, Belgium.) July 26th. (Complete.)

17,028. "Application of radio-active phenomena to telephony." A. Vojen. (Convention date, March 4th, 1911, Belgium.) June 25th. (Complete.)

17,039. "Electric lamps or filaments therefor." M. Weertz. July 25th.

17,040. "Alternating-current commutator generators." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) July 25th. (Complete.)

17,046. "Safety device for electric cables." Siemens-Schuckertwerke G.m.b.H. (Convention date, July 25th, 1910, Germany.) July 25th. (Complete.)

17,051. "Electric alarm clock." F. Goss. July 25th. (Complete.)

17,053. "Make and break device for the primary circuit of electro-magnetic ignition." W. Heyer. (Convention date, July 25th, 1910, Germany.) July 25th. (Complete.)

17,060. "Electric furnaces." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) July 25th.

17,061. "Electrical igniters for gas, oil and similar internal combustion engines." A. R. Bellamy. July 25th.

17,064. "Signalling apparatus." Graham & Latham, Ltd., and L. J. Graham. July 25th.

17,086. "Automatic electric burglar alarm, working with its circuit open or closed, and fed by a double circuit connected to the two terminals of a single battery producing a constant current." H. C. Basuyau and V. A. Leroux. July 26th.

17,110. "Means for cooling enclosed electrical machines." E. Huther. (Convention date, July 26th, 1910, Germany.) July 26th. (Complete.)

17,121. "Electrical switches particularly adapted to electric light sockets." H. W. Lake. (R. A. Schoenberg & Co., U.S.) July 26th. (Complete.)

17,132. "Manufacture of electric accumulator electrodes and means for use therein." R. Pape. (Addition to 905 of 1911.) July 26th.

17,140. "Electro-pneumatically or electrically-operated organ or multiple instrument-playing mechanism and the like." A. R. Trist. July 26th.

17,142. "Magnetically-operated switch." C. B. Larzelere. (Convention date, August 2nd, 1910, United States.) July 26th. (Complete.)

17,149. "Electrical oscillation apparatus particularly adapted for use in wireless telegraphy." G. C. Dymond. (Ges. fur Drahtlose Telegraphie m.b., Germany.) July 26th. (Complete.)

17,151. "Telegraphic systems." P. Faiella. (Addition to No. 4,920/1911. Convention date, July 30th, 1910, Italy.) July 26th. (Complete.)

17,162. "Magnetic-control of buoyant figures and the like floating in a liquid." T. Sendall. July 27th.

17,179. "Manufacture of electric steel." V. Stobie. July 27th.

17,189. "Means for direct-coupling internal-combustion engines and dynamos." V. R. Nicholson and H. R. Ricardo. July 27th.

17,204. "High-tension distributors for electrical ignition systems for internal combustion engines." F. H. Royce and Rolls-Royce, Ltd. July 27th. (Complete.)

17,208. "Current transformer for high voltages." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt-Ges., Germany.) July 27th (Complete.)

27,211. "Semi-automatic telephone exchange systems." F. T. McBerty. (Convention date July 27th, 1910, United States.) July 27th. (Complete.)

17,214. "Devices for controlling cocks, switches and the like." D. Anderson. July 27th.

17,263. "Earthing device for electrical conduit fittings." W. K. Partington. July 28th.

17,281. "Electric cells." A. P. H. Pouteaux. July 28th. (Complete.)

17,284. "Automatic circuit breakers." E. A. Fagerlund. (Convention date August 8th, 1910, Sweden.) July 28th. (Complete.)

17,286. "Electric switching devices." H. S. Hatfield. July 28th.

17,294. "Supports for electrical conductors." Callender's Cable and Construction Co., Ltd., and C. W. Kay. July 28th. (Complete.)

17,300. "Telephones." B. Gwozdz. (Addition to 11,234 of 1911. Convention date, December 2nd, 1910, Germany.) July 28th. (Complete.)

17,304. "Method of and device for locking the high tension of electrically-driven vehicles." Allgemeine Elektricitats Ges. (Convention date, August 18th, 1910, Germany.) July 28th. (Complete.)

17,347. "Wiring for electric lighting and for analogous purposes." W. T. Henley's Telegraph Works Co., Ltd., and W. F. Bishop. July 29th.

17,357. "Process for the removal of scale and oxide from iron and steel surfaces and the like." S. O. Cowper-Coles. July 29th.

17,358. "Apparatus for use in electroplating." S. O. Cowper-Coles. July 29th.

17,359. "Apparatus for scouring or cleaning tubes, rods and the like." S. O. Cowper-Coles. July 29th.

17,360. "Apparatus for use in electro-plating." S. O. Cowper-Coles. July 29th.

17,361. "Apparatus for pickling and electro-plating small articles." S. O. Cowper-Coles. July 29th.

17,362. "Electro-galvanising." S. O. Cowper-Coles. July 29th.

17,363. "Telephones." B. Gwozdz. (Convention date, June 3rd, 1911, Germany.) July 29th. (Complete.)